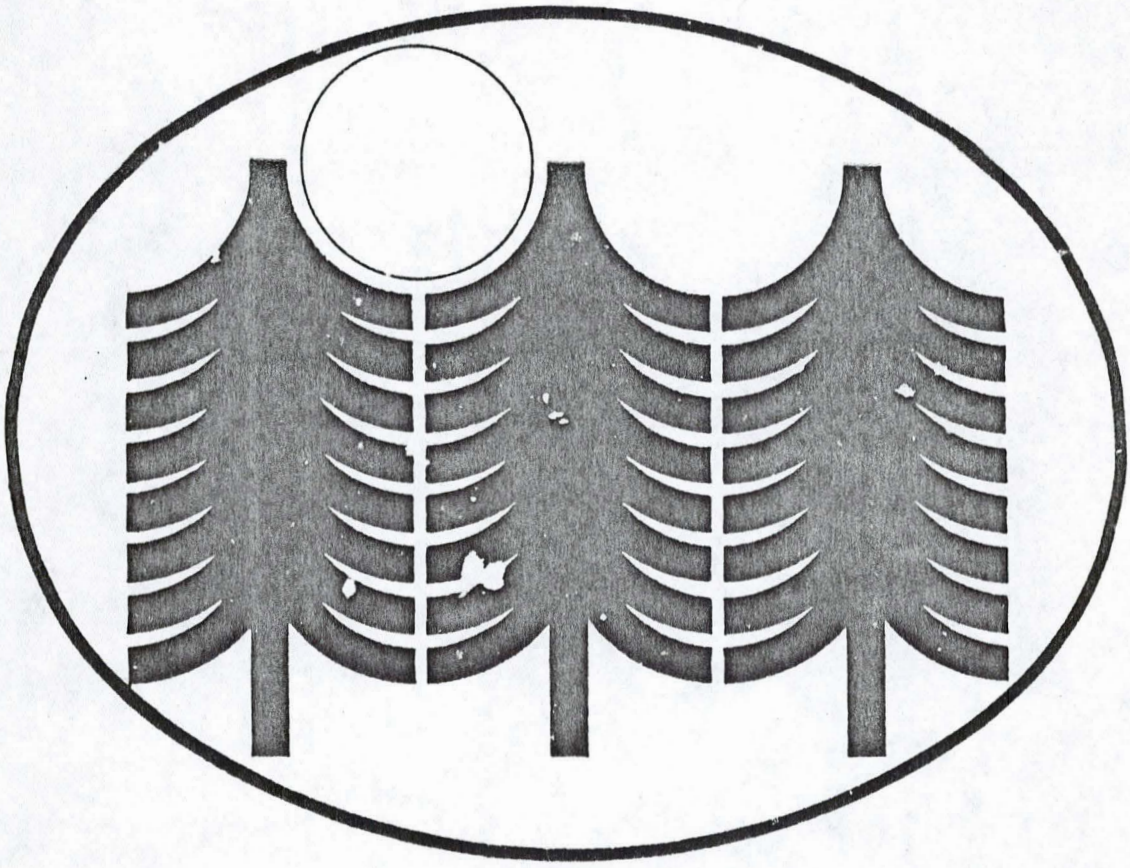
S92 0146

BECKLEY



DEVELOPMENT OF A CAMPGROUND VEGETATIVE MANAGEMENT PLAN

84

This paper was prepared as a student project in partial fulfillment of the requirements of the Professional Development for Outdoor Recreation Management program at Clemson University. It in no way reflects USDA Forest Service policy nor are the opinions expressed those of anyone other than the author.

John Beckley
Sulphur R.D.
100 U.S. Highway 34
Granby, CO

TABLE OF CONTENTS

CHAPTER I - Introduction	1-4
Introduction	1
Statement of the Problem	2
Hypothesis	3
Basic Assumptions	4
Limitations	4
CHAPTER II - Review of Literature	5-20
Trampling	6
Soils	8
Vegetation	11
Understory Vegetation	14
Campsite Conditions	16
Overstory Vegetation	17
Recreational Behavior and Visitor Impacts	18
CHAPTER III - Procedures	21-23
Procedures	21
Subjects	21
Collection of the Data	22
Treatment of the Data	23
CHAPTER IV - Analysis of Data	24-33
Overview	24
Specific Data	25
Soils	25
Erosion	25
Trails	28
Timber	29
Campsite Occupancy	32
CHAPTER V - Summary and Procedures	34-46
Summary	34
Conclusions	35
Discussion and Implications	35
Recommendations	36
Soils	37
Erosion	38
Trails	40
Timber	40
Occupancy Rate	43
Treatment Priorities	45
Monitoring	45

LITERATURE SITED

APPENDICES

A - Location Map
B - Forest Plan and ASIP
C - Soil Vegetative Management Units
D - Channel Erosion, Sheet Erosion
E - Existing Trails
F - Timber Vegetative Management Units
G - Occupancy Rate

CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

INTRODUCTION

Stillwater Campground is located within the Arapaho National Recreation Area (ANRA) and is administered by the Sulphur Ranger District, Arapaho and Roosevelt National Forests. The ANRA is approximately a two hour drive from the front range of Colorado, which contains almost two million residents. Use generally exceeds design capacity on weekends and holidays.

Specifically, Stillwater Campground is located nine miles north of Granby, Colorado, on State Highway 34 and on the west shoreline of Lake Granby (See Appendix A). The campground presently accomodates several developments including: 148 camping units, a boat launch and boat launch parking area, two seasonal "ranger" homes, and an amphitheater. These developments occur on a thirty-four acre parcel of land. The campground is heavily used from late May through mid-September. An average of 450 vehicles per day enter the campground and boat launch area during these summer months. Peak use is at 1500 vehicles per day during the popular camping holiday weekends. Besides the 148 camping units, the campground has six flush toilets (six stools

each), one vault toilet, ten water hydrants, one well and ten garbage dumpsites. About twenty to twenty-five percent of the campground users will bring boats to the area.

The campground vegetation has been showing signs of wear and tear. Mature trees are dying and there is little regeneration occurring. Hazard and disease trees from a 2"DBH and greater have been removed at a rate of approximately 200 per year over the last five years.Because of the lack of firewood, the visitors must either bring their own or buy from a permitted concessionaire. At the present time, all campsites (measured 2 meters from table center) can be evaluated to be in the Frissell(1978) Condition Class 4 or 5.

STATEMENT OF THE PROBLEM

A significant amount of research has been conducted in the past twenty to thirty years concerning vegetative impacts in developed recreation sites. However, these studies have been in separate speciality fields (i.e. soils, trampling, ground cover), and seldom overlap to examine multiple consequences.

The present deteriorated condition of vegetation in most older and heavily-used developed camping sites have left the recreation manager with a new challenge - "How do I correct or reverse the loss of vegetation occuring in developed

recreation areas?" The development and implementation of vegetative planning may be the answer. However, specific guidelines for developing a vegetative management plan are lacking and the impacts continue.

The purpose of this study is:

1. Determine which data is needed to evaluate the present condition of the existing vegetation.

2. Examine that data to establish the present existing vegetative conditions.

3. Develop a vegetative management plan for Stillwater Campground from the inventoried condition.

4. Establish a monitoring system to evaluate the long-range effects of the vegetative management plan.

HYPOTHESIS

It is anticipated that a process of integrating research data with specific campground impacts will result in developing a campground vegetative management plan. This plan should then develop mitigating measures which will establish vegetative regeneration.

BASIC ASSUMPTIONS

1. Some type of vegetative management will need to occur in Stillwater Campground.

2. Recreational impacts will remain constant.

3. The actual work will be funded and continue over a three year period.

4. Recreation use and patterns will remain the same.

5. Soil compaction will increase.

6. The loss of campground vegetation will continue.

LIMITATIONS

This study will not attempt to deal with the sociological aspects of recreational use or user behavior. The study will describe specific field methods that can be used to correct and improve the campground vegetation. These methods will not be site-specific (camp unit). Some field data collection, such as grass identification and bare soil measurements, are not possible this time of year.

CHAPTER II

REVIEW OF LITERATURE

Some research work has been dedicated to the subject of recrecational effects on campsites, both developed and dispersed. Dunn(1984) lists over forty publications that deal with that subject. A significant majority of this research concentrates in three major areas: that of soil relationships, ground cover, and trampling. However, these studies have been conducted throughout a wide scope of ecosystems and they represent a wide variety of vegetative types and soils. Other studies reflect the recreational effect on overstory/understory vegetation, campsite conditions (primarily wilderness), recreational facilities, and visitor use/behavior patterns.

A significant majority of the authors agree that the major concerns are that of soil compaction and vegetative loss. Researchers also agree that the actual feature of continued camping use will not allow for biological impacts to be totally corrected. Many of the researchers also stated that the final product of any vegetative management program is a function of the established management objectives.

A. TRAMPLING

The overwhelming conclusion of research examining recreational impacts on campsites was that vegetation will adjust to this affect. LaPage(1967) noted that the species composition of the original plant cover undergoes a gradual rearrangement in which the more compaction and drought-resistant species become increasingly abundant. His studies showed that recreation tolerant species of ground cover will take over while the less resistant species will decline. Ground cover losses were also generally higher on campsites with stationary picnic tables. This study also reflected that "trampling expressed simply as man-days of use, is not an adequate measure of the impact of camping on vegetation."

Echelberger(1971) reported that lateral screening (low vegetation that provides privacy to a site) decreased five percent and this could be part of a trend that would seriously detract from the camping amenities. His study, begun in 1964, showed that ten percent of forty-nine tent sites were surrounded by fifty percent or more lateral screening; in 1969, only five of the sites had this type of screening.

Cieslinski and Wagar(1970) stated that the survival of vegetation was greatest on the coolest slopes and poorest on

the hotter slopes. They also reported that surviving vegetation decreased as elevation increased. This is explained by the fact that the higher elevations have a shorter season and the vegetation is less well developed at the start of trampling.

In studying the trampling effects on trail vegetation, Dale and Weaver(1974) found: 1) A narrow band of vegetation (1-2 meters) at trail edges is impacted by use; and 2) Some trail edge plant species disappear, some are largely unaffected, and others invade these areas.

Indicated Management Possibilities:

1. Various methods of altering the use patterns should provide a basis for vegetative regrowth.

2. A select method of planting lateral screening and/or "barrier" vegetation may prevent further trampling and assist in vegetative growth.

3. Establishing "routes of travel" could provide access to various facilities and reduce indiscriminate trampling.

B. SOILS

In all the examined studies, each researcher reported that recreational use increased the soil compaction, and soil compaction decreased with an increase in distance from th center location of the activity.

Lutz(1945) reported that within picnic areas soil density greatly increased and both soil pore volume and air capacity decreased. His study also showed "that ground vegetation and tree seedlings disappeared from sites subjected to intensive use." Within the study area, the soils receiving intensive use were about one-twentieth as permeable as that in the non-used area.

In 1982, Vimmesstedt, Scoles, Brown, and Schmittgen stated that "camping impact reduced infiltration of simulated rainfall on excessively drained and well-drained soils, but not on a poorly drained soil. Infiltration on the excessively drained sandy loam soil was especially sensitive to use. Sediment in runoff water and soil bulk density were both highest in heavily used parts of campsites and lowest in relatively undisturbed areas. Infiltration of simulated rainfall was higher in spring than in the preceding fall, indicating some recovery of soil properties controlling infiltration during the winter."

Ward and Berg(1973) found that soil compaction decreased with an increase in distance from the center of trails, and camping and picnicking areas were more compacted than were unused forested areas.

Dawson and Gordon(1974) reported: 1) Recreation impacts were least severe on north slopes, followed by bottomlands, and these impacts were most severe on south slopes; 2) Natural site differences had a greater influence on vegetation composition than did recreation use; and 3) Soil composition was found to be almost totally limited to the trail itself.

Legg and Schneider's research (1977) reported that continued site deterioration was evidenced by changes in litter cover, soil bulk density, macropore space, and depth to A2 horizon. Rates of deterioration increased greatly with the intensity of use. Off-season recovery of these parameters was significant, but depth to the A2 horizon remained unchanged during the winter months. By early July of the following season all improvements had been offset by continued site deterioration.

Dotzenko, Papamichos, and Romin(1967) reflected several problems in recreational areas: 1) Organic matter showed higher contents in lightly used areas and lower contents in heavily used areas; 2) Soil compacting effect of intensive recreational use produces infiltration, runoff and erosion

problems; 3) Soil moisture content was higher in lightly used sites and heavy use significantly reduced surface soil moisture content.

The major findings of Settergren and Cole(1970) were: 1) Bulk density was significantly higher on recreation sites; 2) Field capacity and the permanent wilting percentage was lower for the surface three inches of soil on campsites; 3) Trees on recreation sites had crown wilting and stag-heading due to the lack of soil moisture; 4) A scarcity of roots occurred in the upper six inches of campsite soil; and 5) Campsites were heavily impacted by sheet erosion. The studies of Young and Gilmore in 1976 reflected that "no significant differences were found between soil properties for interior and exterior areas of campingsites but soil compaction increased with camping use".

Indicated Management Possibilities:

1. Well-planned and developed trails in developed sites will concentrate use where it can be managed.

2. Site rotation/resting can aid in vegetative rehabilitation.

3. Soil quality can be improved either by mechanized or physical (barriers, etc) and preferably by a combination of both.

4. Natural and artificial features will aid in maintaining soil quality by providing barriers.

5. The relationship of soil-vegetation-user behavior must be examined and understood to assure long-term improvement of campground vegetation.

C. VEGETATION

The researchers found when ground cover was planted from seed that significantly more vegetation was produced when the seed was combined with water and fertilizer. This combination had to be on a continuous basis for at least the first three growing seasons.

Herrington and Beardsley(1970) showed that rates of change took the following form:

Treatment	Years to produce 70% cover
Seed only	never
Fertilizer & seed	at least 20
Water & seed	at least 10
Water, fertilizer & seed	at least 3

Magill and Nord(1963) examined 137 California developed sites and found: 1) Over half of all sites contained no tree seedlings; 2)Thirty percent of all trees were found to be of poor vigor; 3) Insect damage to trees was found on twenty-eight percent of the campsites; 4) Over half of the sites contained no natural screening, shrub layer, grasses or forbs; 5) Shrubs were only found on moist sites; 6) Seventy percent of all sites had been damaged by erosion, trampling, and mechanical damage; 7) Some trees were found to benefit from recreation use by being released from competition; and 8) Sixty-six percent of the sites had poor accumulation of protective plant litter.

Magill(1970) returned to five of the campgrounds studied in the abcve-mentioned paper and reported the following changes in the vegetative habitat: 1) Total number of saplings declined on recreation sites; 2) Seedlings increased on all study areas but one; 3) Trees in the pole class remained stable or grew more numerous on study areas; 4) Ponderosa pine (Pinus ponderosa) appeared to be susceptible to recreation damage; 5) Tree growth was not effected by recreation use; 6) Coverage of forbs increased on all sites; 7) Shrub coverage was stable but decreased eleven percent on one study area; 8) Percent of soil surface covered by plant litter increased between eighteen and thirty-two percent on all study areas but one, which had an eight percent increase; and 9) Interunit screening increased by an average of

twenty-five percent on all but two sites, where it had remained stable. This improvement was due to some occurring wet years, site protection and site treatment.

Ripley(1962) found: 1) Increased recreation use was found to be directly related to a reduction in the hydrologic condition of soil; 2) Texture of the B horizon was associated with changes in the depth of the A horizon and hydrologic condition; 3) As table density increased, depth of the A horizon decreased; 4) The more fertile the site, the greater the deterioration from recreation use; 5) The amount of understory and damage resulting from erosion increased with increases in crown closure; 6) Site damage increases when the number of tables per acre goes up; 7) Shrub barriers were found to compress use and cause greater localized site damage; 8) Increased shrub barriers were related to reductions in tree injury; and 9) High canopies were associated with bare ground, erosion, and tree damage.

Indicated Management Possibilities:

1. A system of "directed" travel routes are necessary to protect campground vegetation.

2. Any plantings must be accompanied by watering and fertilizing.

3. Barriers, artificial or vegetative, will help in protecting and/or establishing campground vegetation.

D. UNDERSTORY VEGETATION

All of the researchers agreed that recreational camping severely limits ground vegetation, and this activity also inhibits the ability of the soil to recover from continued impacts.

Beardsley and Wagar(1971) reported: 1) A decrease in ground cover occurs with increasing percentage of conifers in the overstory; 2) Watering, fertilizing and seeding increases ground cover; 3) Water is the most important single factor in maintaining ground cover; and 4) Fertilizer alone has little influence on ground vegetation.

Fay(1975) found that "fencing out" resulted in a gradual increase in ground cover. Little and Mohr(1979) stated that mulching, scarifying, and excluding recreational use were highly effective in improving soil conditions. They also reported: 1) Tree reproduction increased fourteen times in fenced areas; and 2) That with protection and maintenance, herbaceous plant cover increases fifty to eighty percent.

While experimenting with planting stock, Cordell and James(1971) found that small, unballed planting stock cannot

be expected to supplement understory vegetation, and planting stock is susceptible to competetion, dry weather, and trampling.

Cordell and Talhelm(1969) reported that young grasses cannot withstand recreational use.

Cordell, James and Tyre(1974) showed that heavy overstories limit the establishment and survival of grass, and volunteer grasses did better than sown species.

Indicated Management Possibilities:

1. Planting grass is impractical and highly expensive.

2. Planting small, unballed seedlings is impractical.

3. Recreational use should be confined to paths of immediate camping areas.

4. Barriers can maintain ground cover.

5. Any treatment of ground cover should include watering, seeding, and fertilizing.

6. Overstory management increases the quality/quanity of ground cover.

E. CAMPSITE CONDITIONS

Research in this area varied from reports on the Boundary Waters Canoe Area to the Bob Marshall Wilderness. However, all researchers reported that recreational use within the campsites impacted soil conditions and ground cover.

Cole(1983) stated that recreational use reflected a loss of organic materials, and non-native species invaded areas where native species had been lost.

Dunn, Lockaly and Johnson(1980) showed that camping reduced ground cover and tree regeneration. They also found that light use resulted in significant decreases in the percent of lost ground cover.

Merriam, Smith, Miller, Huzng, Tappeiner, Goeckermann, Bloemendal and Costello(1973) reported: 1) People tend to expand to new campsites as older ones become dusty or bare of vegetation; 2) Generally, users that see a site only once are not aware of physical changes; and 3) Sites had shallow soils, compaction erosion, and tree windthrow.

Indicated Management Possibilities:

1. Visitor education is necessary to consciously reduce campsite impacts.

2. Campsite impacts can be reduced by creating barriers or establishing concentrated pathways.

3. Where possible, a use-rotation would relieve continued intensities.

F.OVERSTORY VEGETATION

Research specific to timber management with campgrounds is very limited. Of the three reports found, one (Hinds, 1970) was concerned with only campgrounds located in the Aspen-type.

Barker(1980) reported that failure to grow trees in recreational sites were due to 1) faulty watering; 2) trees planted too deep; 3) no regular fertilizing of the planted trees; and 4) other vegetative competition. He also stated that the best probable size for planting was a tree one meter in height. The other paper by Nylund, Nylund, Kellomaki and Haapanen(1979) examined camp areas in southern Finland. They suggest that tree protection is necessary to prevent physiological changes in the tree.

Indicated Management Possibilities:

1. Once the decision to plant trees in a recreation site is made, several years of watering and fertilizing will be needed for survival.

2. Protection of the planted stock is necessary.

G. RECREATIONAL BEHAVIOR AND VISITOR IMPACTS

Numerous publications have related visitor behavior and impacts upon campsites and other recreational facilities, but only a few directly relate to vegetative management. Those authors that have dealt with visitor use-impacts all infer that there is a distinct relationship between the user, use intensity, and the loss of vegetation, soil degredation, trampling and other deteriorating effects on campsites. Many of those researchers feel that some form of management is necessary to halt the continued degradation of the resource.

Frissel and Duncan(1965) relate the impact of use in the Quetico-Superior Canoe Country caused: 1) A reduction of vegetation by eighty-five percent; 2) Trees to be damaged and cut; 3) An increase in soil compaction; and 4) A reduction in the litter/humus layer by sixty-five percent.

In 1964, Wagar examined recreation areas and recognized: 1) vegetative cover was related to intensity of simulated use; 2) vegetation decreased as trampling increased; and 3) large changes in use may cause only small changes in damage on highly developed areas which receive heavy use.

Knudson and Curry(1981) interviewed over 400 campers in three campgrounds and found: 1) Campers were willing to have limits on use imposed; 2) Campers felt the most common solutions to crowding were new or expanded facilities and a limitation on use; 3) Two-thirds of the campers favored closing portions of the campgrounds to improve tree and ground cover; and 4) Campers did not express strong preferences for spacing, and there was not much dissatisfaction for deteriorated ground cover or tree condition. They also found that the campers "enjoyment" of the area was not adversely effected even when the occupancy rate was seventy-five percent.

LaPage and Bevins(1981) showed that camper satisfaction can be measured by having the visitor complete a "report card" for the campground.

The Pacific Southwest Forest and Range Experiment Station report #17/1976 entitled "VANDALISM AND OUTDOOR RECREATION" covers a varied scope of behavior problems which affect the campground vegetation.

Indicated Management Possibilities:

1. Campground design and construction, or reconstruction, should relate to the needs of the user and protect the campground vegetation.

2. A user-education program can reinforce management concerns and bring an awareness of camping impacts to the user.

3. Severely impacted campsites should be allowed to rest.

4. Existing campgrounds can be examined to predict user impacts when rehabilitative work is scheduled and the appropriate changes initiated.

CHAPTER III

PROCEDURES

Specific methodology for developing vegetative management plans is at best insufficient. The Land and Resource Management Plan for the Arapaho and Roosevelt National Forests and the Pawnee National Grasslands, as well as the Area Specific Implementation Plan for the Arapaho National Recreation Area (ANRA) both direct that "existing developed units will be rehabilitated to standard," and that a "healthy vegetative cover will be maintained" (See Appendix B). To reasonably develop a vegetative management plan, specific impacts must be examined.

As described in Chapter II, there is much explained about specific problems, but no attempt has been made to join the solutions in a manner which will correct the multiple impacts.

This chapter deals with specific data gathering needs and the treatment of that data.

SUBJECTS

Current soil conditions, types of erosion, existing trails, current timber stand conditions and campsite occupancy rate were selected as the items to evaluate the present condition of the existing campground vegetation.

These subjects were chosen because the author felt that these items caused the greatest damage when combined. Examimined separately, each feature will reveal an identifiable effect, but an overlapping vegetative impact occurs when a combination of effects is presented.

COLLECTION OF THE DATA

In the collection of the data, each subject was dealt with as follows:

1. Soils - Test sites were randomly selected and examined by the Forest Soil Scientist. Soil samples were taken to a depth of 30 inches. These samples were classified and a profile description was taken. Samples from each horizon were analyzed. Areas were then separated into Vegetative Management Units (VMU's) and specific recommendations were made for each VMU. (See Appendix C for map and soils report).

2. Erosion - The erosion impacts throughout the entire campground were visually mapped by the author. Erosion was identified as either channelized or sheet erosion. (See Appendix D for erosion map).

3. Trails - All trails within the campground were walked and mapped by the author. Since there are no "designated" trails, no distinction was made to separate the preferred and unpreffered trails. (See appendix E).

4. Timber - The author and the Sulphur District Silviculturist sampled the existing timber stand within

the campground by using the standard Region 2 Stage II inventory procedure. The inventory specifications are set out in the R-2 December 1982 edition. (See Appendix F for silviculture report and timber map).

5. Campsite occupancy - The occupancy rate for each unit was determined by using the campground compliance check-sheet. Each day from Memorial Day week-end until the Monday after Labor Day, site occupancy had been recorded as the compliance officer went through the area. This data will help determine which paths are to be eliminated and which trails are to be established as designated walkways. The occupancy rate will also determine what type of management could be used to control vegetative impacts (i.e. continued high use may warrant some type of rest-rotation to accommodate continued vegetative growth). (See Appendix G for site-occupancy data).

TREATMENT OF THE DATA

Once the data is collected, it must be arranged in a meaningful manner which will allow for analysis of the problem. Specific data for each subject can be examined and combined to determine why and/or how the vegetation is impacted, and then what corrective measures can be taken.

CHAPTER IV

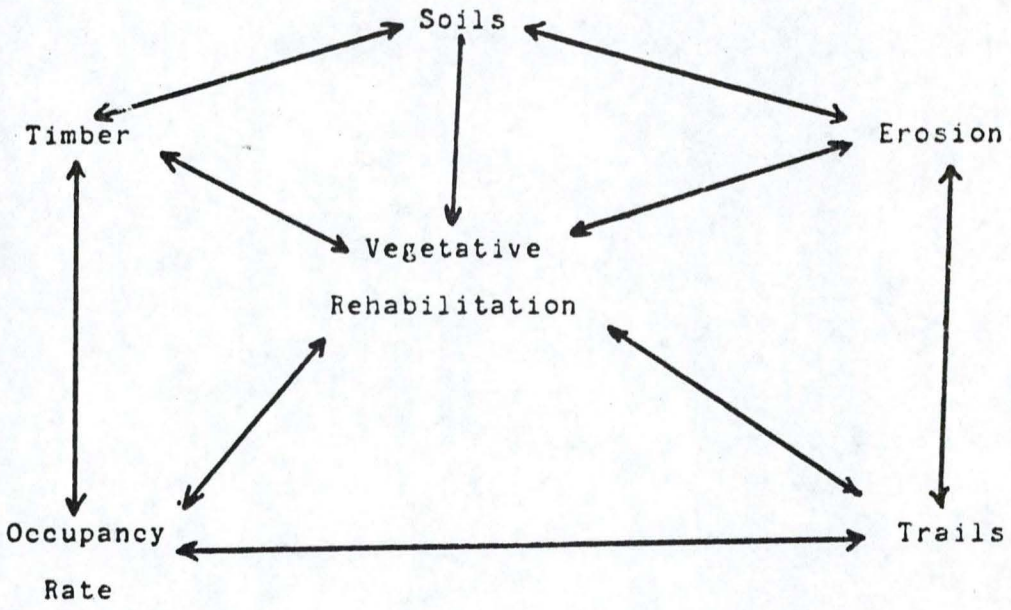
ANALYSIS OF DATA

In order to properly examine the collected data, an overall view will be presented and then each individual subject area will be discussed.

OVERVIEW

Within Stillwater Campground, the existing condition of the soil, erosion, trails, timber stand, and the percent of site occupancy reflect a detrimental impact created by recreational use. While one factor could be corrected, the total force would still be a continual negative effect on the campground vegetation. This is to say that correcting only one impact will not correct the entire problem. The timber stand can be properly managed to eliminate dwarf mistletoe and create a diverse stand (age and species), but this action will not directly help the problem of erosion. In the same terms, corrective action to solve erosion problems will not directly relate to solving the problems of soil compaction. The amount of use received by one specific campsite can be corrected by adjusting that site, but that activity may not directly reduce the total impact on the vegetation.

The total campground impacts are shown to be a relationship of the sum of the parts and any solution must address this feature:



SPECIFIC DATA

This specific analysis of each individual subject is to relate the problem as brought out by data collection.

1. Soils - This examination showed that two types of soils are present and both types are suited to developed recreation areas. However, continuous high recreation use, poor site design, and a lack of maintenance has led to a decline in soil productivity and hydrologic function. Generally, the soils have been so impacted that the ability to naturally recuperate has been lost.

Six specific areas were identified and separated into vegetative management units (VMU). In the following descriptions of each VMU, specific problems will be discussed.

VMU 1 - About twenty-five percent of the unit has active, accelerated soil erosion. Up to five inches of the top soil has been lost in some areas and these areas are mostly associated with the toilet facilities. In at least thirty-five percent of this unit, soil compaction has reached the point where soil penetration is absent. Soil erosion and compaction has caused an extensive loss of ground vegetation and a loss of the litter layer.

VMU 2 - Approximately twenty-five percent of this unit has active soil erosion with a topsoil loss of one to two inches. Erosion gullies up to three feet deep are present along road banks. Soil compaction has reached the critical growth-limiting point on at least twenty percent of this unit with another twenty percent of the area moderately compacted.

VMU 3 - Approximately sixty percent of this unit has active soil erosion with topsoil loss exceeding seven inches in depth. Heavy cross

foot-traffic is evident with extensive gully and rill extensive on the slopes. Soil compaction has reached the critical growth limiting point on about eighty percent of the area.

VMU 4 - Soil erosion is active on about twenty percent of this unit and it is associated with facilities locations and trails. Natural regereration appears to be on a downward trend.

VMU 5 - Soil erosion is active on sixty percent of the unit. The major source of erosion is from surface runoff from the existing roads and toilet facility. Soil loss averages 1/10 to 1/8 of an inch per year. Soil compaction is near the growth limiting point on about thirty percent of the unit.

VMU 6 - Active soil erosion occurs in approximately forty percent of this unit. Soil productivity has decreased at least one site class and is beyond natural recuperative capacity. Soil compaction is near the critical growth limiting threshold on about thirty percent of the area.

VMU 7 - Soil erosion in this unit is evident along road cut-slopes and trails. Soil disturbance associated with campsites is severely impaired

2. Erosion - Within Stillwater Campground, 5.15 acres of sheet erosion is present and 7760 feet of channelized erosion has occurred. By comparing the erosion and trails maps, there appears to be a direct relationship between the two. There is also an indication that the higher used sites contribute more to erosion than do the less-used sites. This can explained by the fact that the high use sites appear to be located closer to the campground facilities (i.e. water, toilets), and hence more traffic to these facilities. As stated in the literature review, erosion is a function of soil degradation. This impact is also reflected when the existing trails and site occupancy are examined.

3. Trails - Approximately 25,440 feet of existing trails are present. As mentioned in the discussion above with erosion, there is a direct association of trails with erosion. Nearly every site in the campground has at least two recognizable trails leaving from it. These trails go to the campground facilities, other campsites, the shoreline, or the fee collection station. Most of the trails are in a direct line and percent of slope appears not to be a problem at least

for short distances. Because there is no "definition" to the trails, it appears to the public that just "any old way" that gets you there is sufficient. It was also noted during mapping that if a trail was becoming channelized, it was "moved" to one side or the other. Close to the existing facilities, the trails appear to be a major contributor to the effect of sheet erosion, causing the loss of understory vegetation. There was also evidence that if trails were or are located through understory vegetation which appears to create an artificial barrier, these trails were seldom used.

4. Timber - The forest cover in the campground consists of a more or less even-aged "stand" of lodgepole pine averaging about ninety-five years of age. There are about one hundred fifty eight trees per acre averaging 9.6 inches DBH and forty-nine feet in height. Virtually all trees tallied on the plots were greater than five inches DBH and no tree species other than lodgepole pine were observed either on or off the plots with the exception of two small areas of aspen seedlings/saplings located near the administrative residences. Thus, there is a conspicuous lack of trees in the younger age classes. Basal area per acre averages about eighty square feet over the entire area sampled. Damages and diseases noted during the inventory include lodgepole dwarf mistletoe (D-M), dead tops, forked tops,

"unhealthy foliage", and mechanical damage (mostly basal and trunk scars) resulting from use and abuse over the years by campers. Site index, determined using Stage II techniques, is about 50: however, this figure undoubtedly reflects the adverse impact on site productivity that dwarf mistletoe and soil compaction have had. The area is currently in a state of high susceptibility to the Mountain Pine Bark Beetle.

Three specific problem areas were also noted within the timber stand:

A. Stand Structure - The campground stand is even aged, single storied, and lacks regeneration. No seedlings or saplings were found on any of the sample plots. During walk-through exams, the only regeneration observed occurred within clusters of ground juniper which in turn were found primarily in the few areas which have received little foot traffic. This leads to the conclusion that the lack of regeneration in the campground is most probably the result of the heavy human use of the area.

B. Dwarf Mistletoe - Dwarf mistletoe is a host specific parasitic plant which adversely affects trees by reducing growth, vigor, and seed

production. It may increase susceptibility of the host tree to attack by secondary pests, particularly bark beetles. It also may cause direct mortality. The dwarf-mistletoe plant is propagated by seed which is easily spread, both vertically and horizontally, through a forest stand.

As a part of the inventory, the presence of dwarf mistletoe was evaluated for the stand using Hawksworth's six point rating system. When data from all plots is combined the stand's average dwarf mistletoe rating is about 3.5. However, during the inventory, it was observed that a small 4.5 acre area in the east central portion of the campground, VMU 1, was only lightly infected. When the data from this VMU was separated from the rest of the campground data, the average rating for VMU 1 was less than 1.0, while that for the rest of the campground was about 5.0. A recent publication by the Colorado State Forest Service on lodgepole pine management in high value areas recommends that individual trees with ratings greater than 4.0 be removed while those with rating of less than 4.0 may be left and pruned.

C. Mountain Pine Bark Beetle - Attack of lodgepole pine by the Mountain Pine Bark Beetle (MPB) is a recurring problem. For the past several years, Grand County has been experiencing a major eruption of the MPB population. Amman (1977) has developed a scheme for rating the susceptibility of a forest area to attack by the insect. This scheme is currently in use throughout the Rocky Mountain Region. Using it, the location and characteristics of the lodgepole stand in the campground indicate that it is highly susceptible to attack by the MPB and in fact, a number of trees in the campground have been attacked by the beetle in recent years. These attacked trees were removed before the young beetles were ready to emerge and re-attack, thereby reducing tree losses in the campground. Also, a preventive spray program was initiated in the spring of 1984 with the result that loss of trees from MPB attack have been reduced nearly to zero. The MPB is a recurring problem in this area. Any vegetative management plan must take its presence into account.

5. Campsite Occupancy - Campsite ocupancy for weekdays ranges from zero percent to eighty-eight percent. Weekend occupancy is from forty percent to one-hundred

percent. Total season campsite occupancy is from six percent to ninety percent. The average seasonal occupancy rate is forty-six percent. Those sites with higher use occupancy are generally located closer to existing facilities. The exceptions are those sites located near the shoreline which allow for easy boating access.

CHAPTER V

SUMMARY AND PROCEDURES

The current vegetative conditions within various Forest Service campgrounds reflect a need for a practical on-the-ground procedure which will evaluate current conditions and develop a vegetative management plan. The focus of this study was to recommend that methodology.

SUMMARY

Five selected subjects were used to evaluate current vegetative conditions. These were: 1) current soils conditions; 2) types of erosion; 3) existing trails; 4) current timber stand conditions; and 5) campsite occupancy. Each subject was field-mapped and the necessary data collected.

Over fifty research publications were examined. A significant amount of this literature dealt with only three areas: 1) soil relationships; 2) ground cover; and 3) trampling. The implications of the research data and the field data from the five examined subject areas were combined to establish the guidelines for the vegetative management treatment within Stillwater Campground.

CONCLUSIONS

Based upon the findings and within the limitations of this study, impacts upon campground vegetation can be easily identified by examining current soil conditions, present erosion problems, existing trails, timber stand vigor, and occupancy use. These impacts in turn develop the guidelines for a vegetative management plan.

DISCUSSION AND IMPLICATIONS

Any management of a developed recreational facility must include the foresight of vegetative management and a comittment to vegetative management over the long-run time frames. The direct resource loss is continuous with vegetative regrowth held at a minimum.

Based on the campground size, the implementation of a revegetative plan should be expected to take at least two years. The revegetative plan should be incorporated into the redesign because many of the factors that are brought out in the vegetative examination are critical to further planning. Visual features can then be established.

The subject areas examined were those items considered to have the greatest impact on campground vegetation. It is also felt that these subject areas are valid for consideration in almost

any National Forest campground. The impacts and vegetation can easily change from one location to another, but the five subject areas are always present.

The two main implications of this study after examining the collected data are:

1. In the past, vegetative management has been ignored.

2. There must be a recognition of the fact that, in all developed sites, vegetative management is a continuous impact, and corrective actions need to be planned and funded.

RECOMMENDATIONS

By examining each of the five subject areas, a vegetative management prescription can be developed. The author feels that it is not necessary to be site-specific (i.e. "in unit x, this action will be done.") but instead, objectives and guidelines for the discussed subjects will be determined. These objectives and guidelines will then indirectly guide the corrective action for each site.

The following discussion, broken down by subjects, is the proposed vegetative management plan for Stillwater Campground. It should, at this point, be recognized that the optimimum

conditions for correcting vegetative problems may not be fully acceptable due to budget constraints and/or management philosophy.

1. Soils

A. Objective - To stabilize soil erosion, reduce compaction, and improve soil productivity.

B. Guidelines:

1. Mechanically break up compacted soils to a depth of seven inches.

2. Seed, fertilize, and water those areas that are scarified.

3. Physically restrict entry into those areas where immediate compaction could reoccur.

4. Establish a designated trails system throughout the campground.

5. After site preparation, plant understory vegetation where natural regeneration is lacking and where vegetation is needed for long-term slope and soil stabilization.

6. Utilize erosion control fabric in those areas where seeding occurs and/or on slopes greater than five percent.

7. Water runoff should be reduced by installing check dams, water bars and vegetative placement

8. Those areas that have been seeded/planted will have a watering schedule developed for a three-year period.

2. Erosion

A. Objective - To eliminate existing channel and sheet erosion and prevent furthur problems.

B. Guidelines:

1. Plant understory vegetation where it will effectively control erosion problems

2. Close random trails and establish a designated trails system throughout the campground.

3. Install water bars, check dams, and vegetation to reduce the amount of erosion that occurs.

4. Sign all closed areas as being "closed" and utilize campground hosts to explain the vegetative program to the visiting public.

5. Physically restrict entry into those areas that have been treated.

6. Use erosion control fabric to stabilize slopes of five percent or greater, and where planting has been done.

7. All gullies will be plugged and the slopes scarified.

8. Surface runoff from paved roads will be diverted into rip-rap structures built alongside the road.

9. All areas with sheet erosion will be scarified, seeded, fertilized and watered.

3. Trails

A. Objective - Develop a designated trails system which is functional and serves the public need.

B. Guidelines:

1. Close and physically eliminate those trails which add to the erosion problem. Also, close trails of more than seven percent slope and multiple trails.

2. Closed trails will be scarified, seeded, fertilized, and watered.

3. Designated trails will be outlined and surfaced with a base of 3/4" minus gravel, or class "C" material.

4. A system of trail signs will be used to direct use patterns and flows.

4. Timber

A. Objective - Create a vigorous, disease-free stand which is diverse in respect to age and species.

B. Guidelines:

1. Plant seedlings of various species. Lodgepole should account for at least sixty percent of the stand.

2. Seedling planting will be completed prior to Memorial Day weekend.

3. Transplants (12 feet +) will be selected from the immediate area and planted in the campground.

4. Transplants will be utilized primarily as screening at campsite units.

5. Seedling spacing of planted 3.0 stock will be 5-7 feet.

6. Cutting units will be prioritized to be located in those sub-stands which have the least prospect of surviving until the year 2055 (i.e. effects of dwarf mistletoe, recreational impacts, and compacted soils).

7. The cutting method will be by unit selection on a 10 year entry basis. The stand will be completely treated by the year 2055.

8. Cutting unit configuration will basically maintain a 100 foot opening.

9. Regardless of species, planting stock should be carefully chosen to match the site characteristics of Stillwater Campground.

10. Pruning for dwarf mistletoe will be done every five years to protect the regeneration and to improve the stand vigor.

11. Every five years a dwarf mistletoe survey will be done in order to evaluate preventive measures.

12. During the periods of dwarf mistletoe seed dissemination, protective cloth barriers will be installed to protect existing regeneration. This will continue on an annual basis until dwarf mistletoe is eliminated.

13. Regeneration thinning will be used to promote stand vigor.

14. Trees that show "hits" from Mountain Pine Bark Beetle (MPB) will be cut and removed annually prior to June 1.

15. The preventive spraying program will continue on an every other year basis.

16. An annual walk-through inspection will be held to look for further MPB infestation.

5. Occupancy Rate

A. Objective - Continue site use while changing use patterns which are detrimental to campground resources.

B. Guidelines:

1. Develop and install a defined trail system leading from campsites to destination points within the campground.

2. Plant shrubbery for lateral screening and "barrier" effect.

3. Develop a public awareness program to educate campers on cause and effect.

4. If a "family" wants to stay in Stillwater Campground longer than the present seven day limit, their time will be extended at a ratio of two days for every eight accumulative hours of volunteer work. This action is controlled by:

a). Work that is directly related to vegetative rehabilitation.

b). Time will not exceed a ten day extension.

c). No more than five families at one time will be used.

d). All volunteer agreements will completed prior to time extension.

e). Camping fees will be waived based on completed volunteer work.

5. Physical barriers will be installed to direct foot traffic.

6. A use-rotation system for sites with 75 percent seasonal occupancy will be used if vegetation associated with a site continues to deteriorate.

7. A "report card" evaluation of the campground will be initiated during the summer of 1986 (reference LaPage and Bevins [1981]).

TREATMENT PRIORITIES

Finally, based upon available research information, collected field data, and examining the existing problems, the VMU's are prioritized as follows for vegetative treatment:

1. VMU 3
2. VMU 5
3. VMU 1
4. VMU 6
5. VMU 2
6. VMU 4
7. VMU 7

MONITORING

The vegetative conditions in Stillwater Campground will be monitored by the following system:

1. Photo points will be established and pictures taken each spring and fall.

2. Soils surveys will be taken every five years.

3. Stage II datum will be collected every five years.

4. Field mapping will be done every five years.

5. All collected datum will be kept to establish historical records, which will provide long-term records.

REVIEW OF LITERATURE

Dunn, B. A. and W. D. Carroll. 1984. "Floristic Assessment of Campsites in the Blue Ridge Region of South Carolina." For. Series No. 40. Depart. of For., Clemson Univ., Clemson, South Carolina. 95 pp.

LaPage, W. F. 1967. "Some observations on campground trampling and ground cover response." USDA For. Serv. Res. Paper NE-68, Northeastern For. Exp. Stn., Upper Darby, Pennsylvania. 11 pp.

Echelberger, H. E. 1971. "Vegetative changes at Adirondack Campgrounds: 1964 to 1969." USDA For. Serv. Res. Note NE-142, Northeastern For. Exp. Stn., Upper Darby, Pennsylvania. 8 pp.

Cielsinski, T. J. and J. A. Wagar. 1970. "Predicting the durability of forest recreation sites in northern Utah--preliminary results." USDA For. Serv. Res. Note INT-117, Intermountain For. and Range Exp. Stn., Ogden, Utah. 7 pp.

Dale, D. and T. Weaver. 1974. "Trampling effects on vegetation of the trail corridors of North Rocky Mountain forests." J. Appl. Ecol. 11(2):767-772.

Lutz, H. J. 1945. "Soil conditions on picnic grounds in public forest parks." J. For. 43(2):121-127.

Ward, R. M. and R. C. Berg. 1973. "Soil compaction and recreation use." Prof. Geograph. 25(4):369-372

Dawson, J. O., P. N. Hinz, and J. C. Gordon. 1974. "Hiking-trail impact on Iowa stream valley forest preserves." Iowa State J. Res. 48(4):329-337.

Legg, M. H. and G. Schneider. 1977. "Soil deterioration on campsites: northern forest types." Soil Sci. Soc. Am. J. 41:437-441.

Dotzenko, A. D., N. T. Papamichos, and D. S. Ronine. 1967. "Effects of recreational use on soil and moisture conditions in Rocky Mountain National Park." J. Soil and Water Conserv. 22(5):196-197.

Settergren, C. D. and D. M. Cole. 1970. "Recreation effects on soil and vegetation in the Missouri Ozarks." J. For. 68(4):231-233

Young, R. A. and A. R. Gilmore. 1976. "Effects of various camping intensities on soil properties in Illinois campgrounds." Soil Sci. Soc. Am. J. 40:908-911.

Herrington, R. B. and W. B. Beardsley. 1970. "Improvement and maintenance of campground vegetation in central Idaho." USDA For. Serv. Res. Paper INT-87, Intermountain For. and Range Exp. Stn., Ogden, Utah. 9 pp.

Magill, A. W. and E. C. Nord. 1963. "An evaluation of campground conditions and needs for research." USDA For. Serv. Res. Note PSW-4, Pacific Southwest For. and Range Exp. Stn., Berkeley, California. 8 pp.

Magill, A. W. 1970. "Five California campgrounds - conditions improve after 5 year's recreation use." USDA For. Serv. Res. Paper PSW-62, Pacific Southwest For. and Range Exp. Stn., Berkeley, California. 16 pp.

Ripley, T. H. 1962. "Tree and shrub response to recreation use." USDA For. Serv. Res. Note SE-171, Southeastern For. Exp. Stn., Asheville, North Carolina. 2 pp.

Beardsley, W. G. and J. A. Wagar. 1971 "Vegetation Management on a forested recreation site." J. For. 69(10):728-731.

Fay, S. 1975. "Ground-cover vegetation management at backcountry recreation sites." USDA For. Serv. Res. Note NE-201, Northeastern For. Exp. Stn., Upper Darby, Pennsylvania. 5 pp.

Little, S. and J. J. Mohr. 1979. "Reestablishing understory plants in overused wooded areas of Maryland state parks." USDA For. Serv. Res. Note NE-431, Northeastern For. Exp. Stn., Broomail, Pennsylvania. 9 pp.

Cordell, H. K. and G. A. James. 1971. "Supplementing vegetation on southern Appalachian recreation sites with small trees and shrubs." J. Soil and Water Conserv. 26(6):235-238.

Cordell, H. K. and D. R. Talhelm. 1969. "Planting grass appears impractical for improving deteriorated recreation sites." USDA For. Serv. Res. Note SE-105, Southeastern For. Exp. Stn., Asheville, North Carolina. 2 pp.

Cordell, H. K., G. A. James, and G. L. Tyre. 1974. "Grass establishment on developed recreation sites." J. Soil and Water Conserv. 29(6):268-271.

Cole, D. N. 1982. "Wilderness campsite impacts: effect of amount of use." USDA For. Serv. Res. Paper INT-284, Intermountain For. and Range Exp. Stn., Ogden, Utah. 34 pp.

Dunn, B. A., B. G. Lockaby, and E. E. Johnson. 1980. "Camping and its relationship to forest soil and vegetation properties in South Carolina." For. Res. Series No. 34, Depart. of For., Clemson Univ., Clemson, South Carolina. 20 pp.

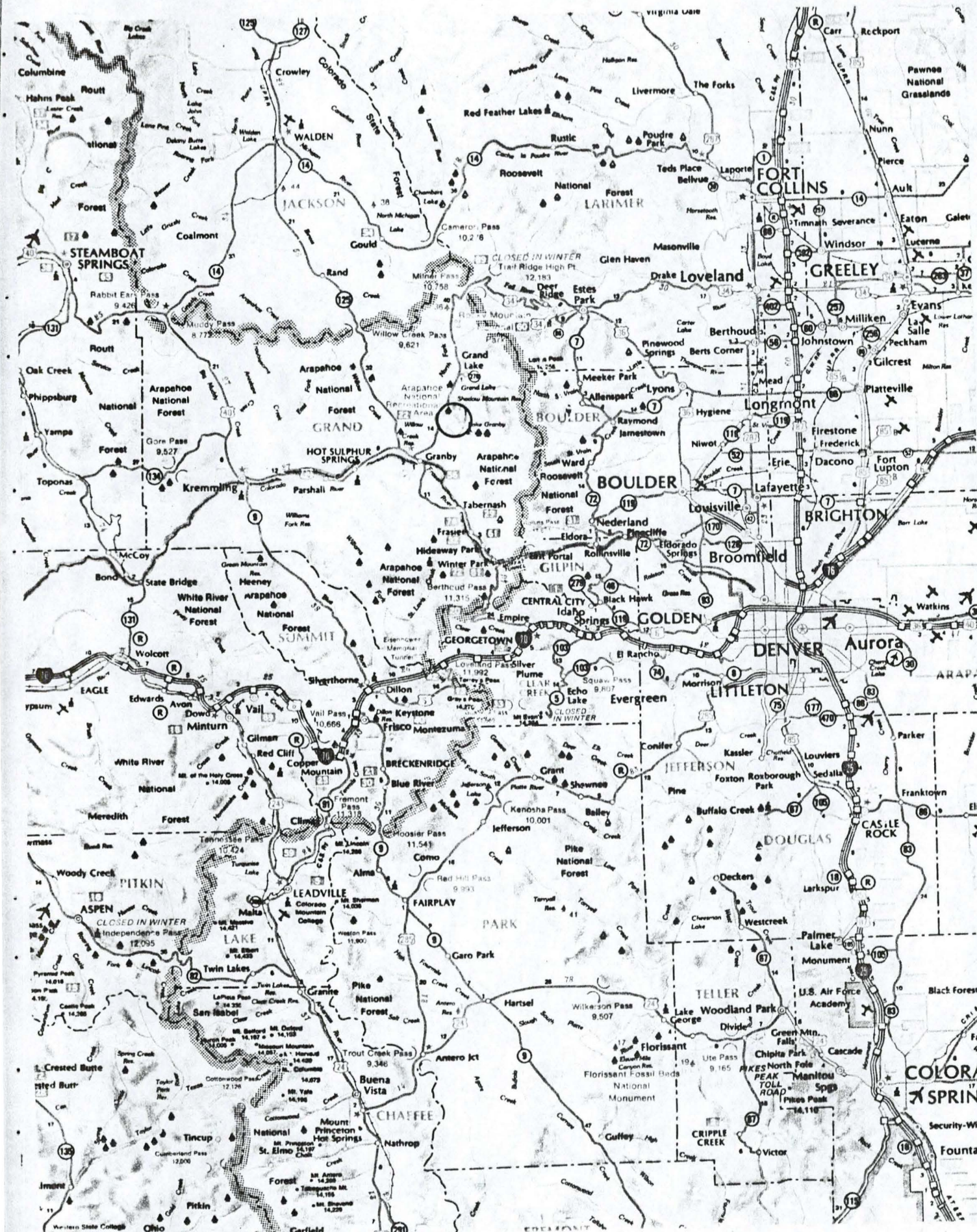
Merriam, L. C., Jr., C. K. Smith, D. E. Miller, C. T. Huzng, J. C. Tappeiner, II, K. Goeckermann, J. A. Bloemendal, and T. M. Costello. 1973. "Newly developed campsites in the Boundary Waters Canoe Area - a study of 5 year's use." Stn. Bull. 511, For. Series 14, Ag. Exp. Stn., Univ. of Minn., St. Paul, Minnesota. 27 pp.

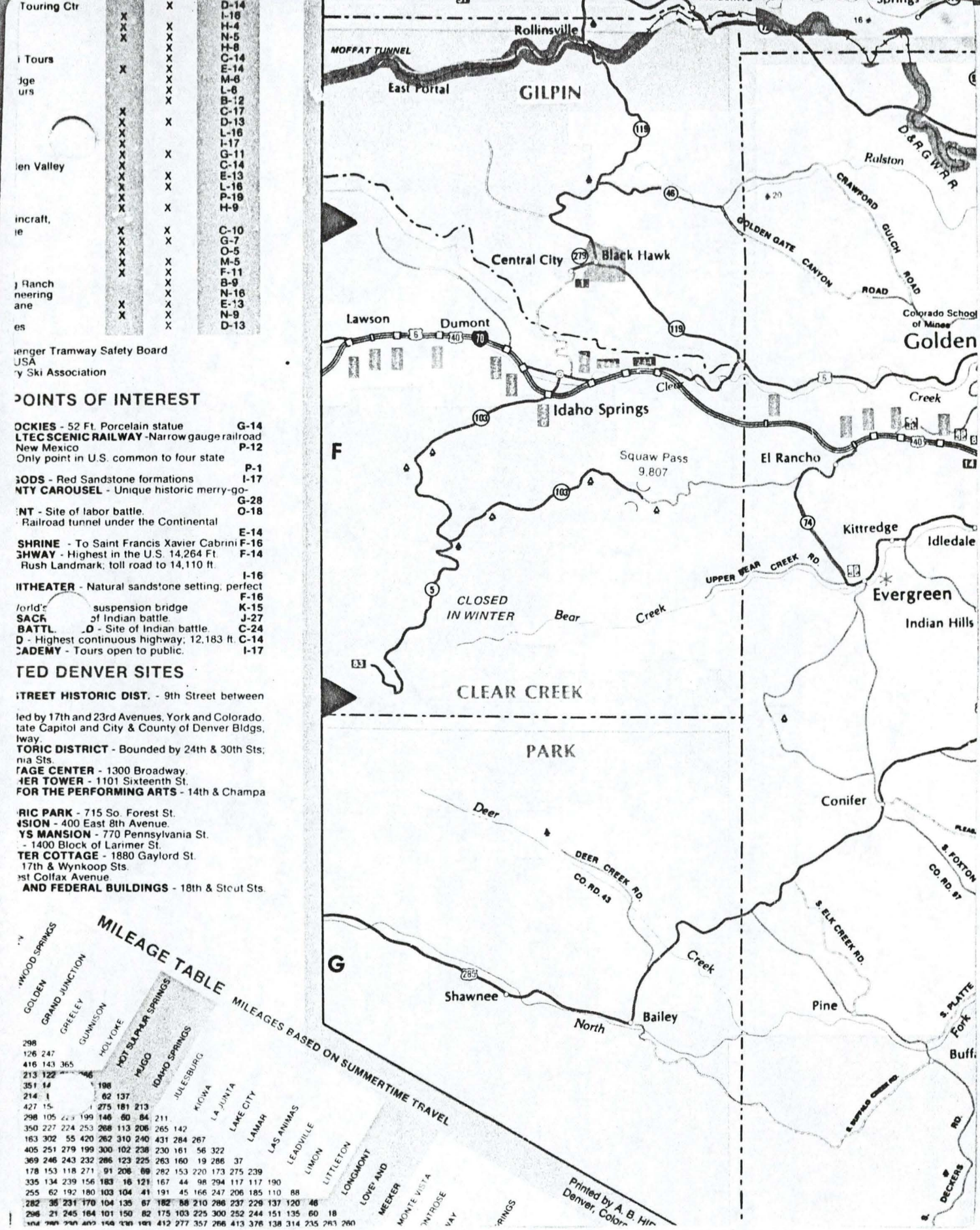
Hinds, T. E. 1976. "Aspen mortality in Rocky Mountain Campgrounds." USDA For. Serv. Res. Paper RM-164. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colorado. 20 pp.

Frissell, S. S., Jr. and D. P. Duncan. 1965. "Campsite preference and deterioration in the Quetico-Superior Canoe Country." J. For. 63(4):256-260.

Wagar, J. A. 1964. "The carrying capacity of wildlands for recreation." Soc. Am. For., For. Sci. Monogr. 7. 23 pp.

Appendix A


FORT COLLINS
GREELEY
Loveland
Longmont
BOULDER
BOULDER
BRIGHTON
Broomfield
GOLDEN
DENVER
Aurora
LITTLETON
Evergreen
Conifer
Parker
Castle Rock
Larkspur
Monument
Palmer Lake
Woodland Park
Florissant
Cripple Creek
Victor
Fountain
COLORADO SPRINGS
Manitou Springs
Pikes Peak
14,110
Garden of the Gods
U.S. Air Force Academy
Black Forest
Security-Widefield
Fountain
Pueblo
Rockport
Pawnee National Grasslands
Nunn
Pierce
Eaton
Windsor
Lucerne
Evans
Milliken
Johnstown
Gilcrest
Platteville
Firestone
Frederick
Dacono
Fort Lupton
Lafayette
Louisville
Superior
Erie
Niwot
Lyons
Hygiene
Berthoud
Loveland
Estes Park
Glen Haven
Masonville
Drake
Berthoud Pass
11,315
Rollinsville
Nederland
Eldora
Tabernash
Granby
Grand Lake
Hot Sulphur Springs
Kremmling
Parshall
Toponas
Yampa
Phippsburg
Oak Creek
Steamboat Springs
Rabbit Ears Pass
9,426
Muddy Pass
8,772
Willow Creek Pass
9,621
Gore Pass
9,527
Coalmont
Gould
Cameron Pass
10,276
Milner Pass
10,758
Trail Ridge High Pt
12,183
CLOSED IN WINTER
Rand
Walden
Crowley
Jackson
Routt
Arapahoe National Forest
Roosevelt National Forest
Arapaho National Recreation Area
Shadow Mountain Res.
Lake Granby
Williams Fork Res.
Green Mountain Res.
Heeney
Bond
State Bridge
McCoy
White River National Forest
Arapahoe National Forest
Summit
Wolcott
Eagle
Edwards
Avon
Dowd
Minturn
Vail
Vail Pass
10,668
Gilman
Red Cliff
Copper Mountain
Breckenridge
Frisco
Keystone
Dillon
Silverthorne
Montezuma
Blue River
Fremont Pass
11,318
Climax
Tennessee Pass
10,424
Leadville
Colorado Mountain College
Fairplay
Alma
Como
Hoosier Pass
11,541
Jefferson
Kenosha Pass
10,001
Bailey
Grant
Shawnee
Red Hill Pass
9,993
Garo Park
Hartsel
Wilkerson Pass
9,507
Trout Creek Pass
9,346
Antero Jct
Buena Vista
Chaffee
Nathrop
Mount Princeton Hot Springs
Tincup
Cumberland Pass
12,000
Pitkin
Gunnison
Western State College
Ohio
Garfield
Aspen
Woody Creek
Meredith
Independence Pass
12,095
Twin Lakes
Granite
San Isabel
Crested Butte
Cottonwood Pass
12,126
Mt. Princeton
14,197
St. Elmo
Mt. Antero
14,269
Tomichi Mt.
14,196
Mt. Shavano
14,229
Mt. Yale
14,196
Mt. Oxford
14,153
Mt. Belford
14,197
Mt. Harvard
14,420
Mt. Columbia
14,073
Mt. Sherman
14,036
Mt. Massive
14,421
Mt. Elbert
14,433
Pyramid Peak
14,018
Castle Peak
14,265
Maroon Bells
14,156
Maroon Mountain
14,051
Snowmass Mtn.
14,092
Lincoln
14,286
Tomichi Creek
Taylor Park Res.
Taylor River
Spring Creek Res.
Lake Creek Res.
Lake Ann
14,256
Grand Lake
Shadow Mountain Res.
Lake Granby
Willow Creek Res.
Meeker Park
Allenspark
Raymond
Jamestown
Ward
Roosevelt
Peaceful Valley
Nederland
Eldora
Boulder
Boulder Creek
Boulder Res.
Gross Res.
Barker Res.
Barr Lake
Milton Res.
Lower Latham Res.
Carter Lake
Horsetooth Res.
Horsetooth Rock
Lone Pine Creek
Upper Poudre
Cache la Poudre River
Poudre Park
Rustic
Red Feather Lakes
Livermore
The Forks
Virginia Dale
Teds Place
Bellvue
Laporte
Timnath
Severance
Eaton
Galeton
Roosevelt National Forest
Arapaho National Forest
Pawnee National Grasslands
Arapahoe National Forest
Routt National Forest
Pike National Forest
Rio Grande National Forest
Gunnison National Forest
Uncompahgre National Forest
Grand Mesa National Forest
Manti-La Sal National Forest
Ashley National Forest
Dinosaur National Monument
Florissant Fossil Beds National Monument
Colorado National Monument
Arches National Park
Canyonlands National Park
Mesa Verde National Park
Great Sand Dunes National Monument
Black Canyon of the Gunnison National Monument
Curecanti National Recreation Area
Blue Mesa Res.
Morrow Point Res.
Crystal Res.
Taylor Park Res.
Taylor River
Spring Creek Res.
Lake Creek Res.
Lake Ann
14,256
Grand Lake
Shadow Mountain Res.
Lake Granby
Willow Creek Res.
Meeker Park
Allenspark
Raymond
Jamestown
Ward
Roosevelt
Peaceful Valley
Nederland
Eldora
Boulder
Boulder Creek
Boulder Res.
Gross Res.
Barker Res.
Barr Lake
Milton Res.
Lower Latham Res.
Carter Lake
Horsetooth Res.
Horsetooth Rock
Lone Pine Creek
Upper Poudre
Cache la Poudre River
Poudre Park
Rustic
Red Feather Lakes
Livermore
The Forks
Virginia Dale
Teds Place
Bellvue
Laporte
Timnath
Severance
Eaton
Galeton
Roosevelt National Forest
Arapaho National Forest
Pawnee National Grasslands
Arapahoe National Forest
Routt National Forest
Pike National Forest
Rio Grande National Forest
Gunnison National Forest
Uncompahgre National Forest
Grand Mesa National Forest
Manti-La Sal National Forest
Ashley National Forest
Dinosaur National Monument
Florissant Fossil Beds National Monument
Colorado National Monument
Arches National Park
Canyonlands National Park
Mesa Verde National Park
Great Sand Dunes National Monument
Black Canyon of the Gunnison National Monument
Curecanti National Recreation Area
Blue Mesa Res.
Morrow Point Res.
Crystal Res.



Touring Ctr		X	D-14
	X		I-16
	X	X	H-4
	X	X	N-5
		X	H-8
i Tours		X	C-14
	X	X	E-14
dge		X	M-6
urs		X	L-6
		X	B-12
	X		C-17
	X	X	D-13
	X		L-16
	X		I-17
	X	X	G-11
len Valley	X		C-14
	X	X	E-13
	X	X	L-16
	X		P-19
	X	X	H-9
incraft,			
ie	X	X	C-10
	X	X	G-7
	X		O-5
	X	X	M-5
	X	X	F-11
ı Ranch		X	B-9
neering		X	N-16
ane	X	X	E-13
	X	X	N-9
es		X	D-13

enger Tramway Safety Board
USA
y Ski Association

POINTS OF INTEREST

OCKIES - 52 Ft. Porcelain statue G-14
LTEC SCENIC RAILWAY -Narrow gauge railroad New Mexico P-12
Only point in U.S. common to four state P-1
GODS - Red Sandstone formations I-17
NTY CAROUSEL - Unique historic merry-go- G-28
NT - Site of labor battle. O-18
Railroad tunnel under the Continental E-14
SHRINE - To Saint Francis Xavier Cabrini F-16
GHWAY - Highest in the U.S. 14,264 Ft. F-14
Rush Landmark; toll road to 14,110 ft. I-16
IITHEATER - Natural sandstone setting; perfect F-16
World's suspension bridge K-15
SACR of Indian battle. J-27
BATTL. .D - Site of Indian battle. C-24
D - Highest continuous highway; 12,183 ft. C-14
CADEMY - Tours open to public. I-17

TED DENVER SITES

STREET HISTORIC DIST. - 9th Street between
led by 17th and 23rd Avenues, York and Colorado.
tate Capitol and City & County of Denver Bldgs,
lway.
TORIC DISTRICT - Bounded by 24th & 30th Sts;
nia Sts.
TAGE CENTER - 1300 Broadway.
HER TOWER - 1101 Sixteenth St.
FOR THE PERFORMING ARTS - 14th & Champa

RIC PARK - 715 So. Forest St.
NSION - 400 East 8th Avenue.
YS MANSION - 770 Pennsylvania St.
- 1400 Block of Larimer St.
TER COTTAGE - 1880 Gaylord St.
17th & Wynkoop Sts.
est Colfax Avenue
AND FEDERAL BUILDINGS - 18th & Stout Sts.

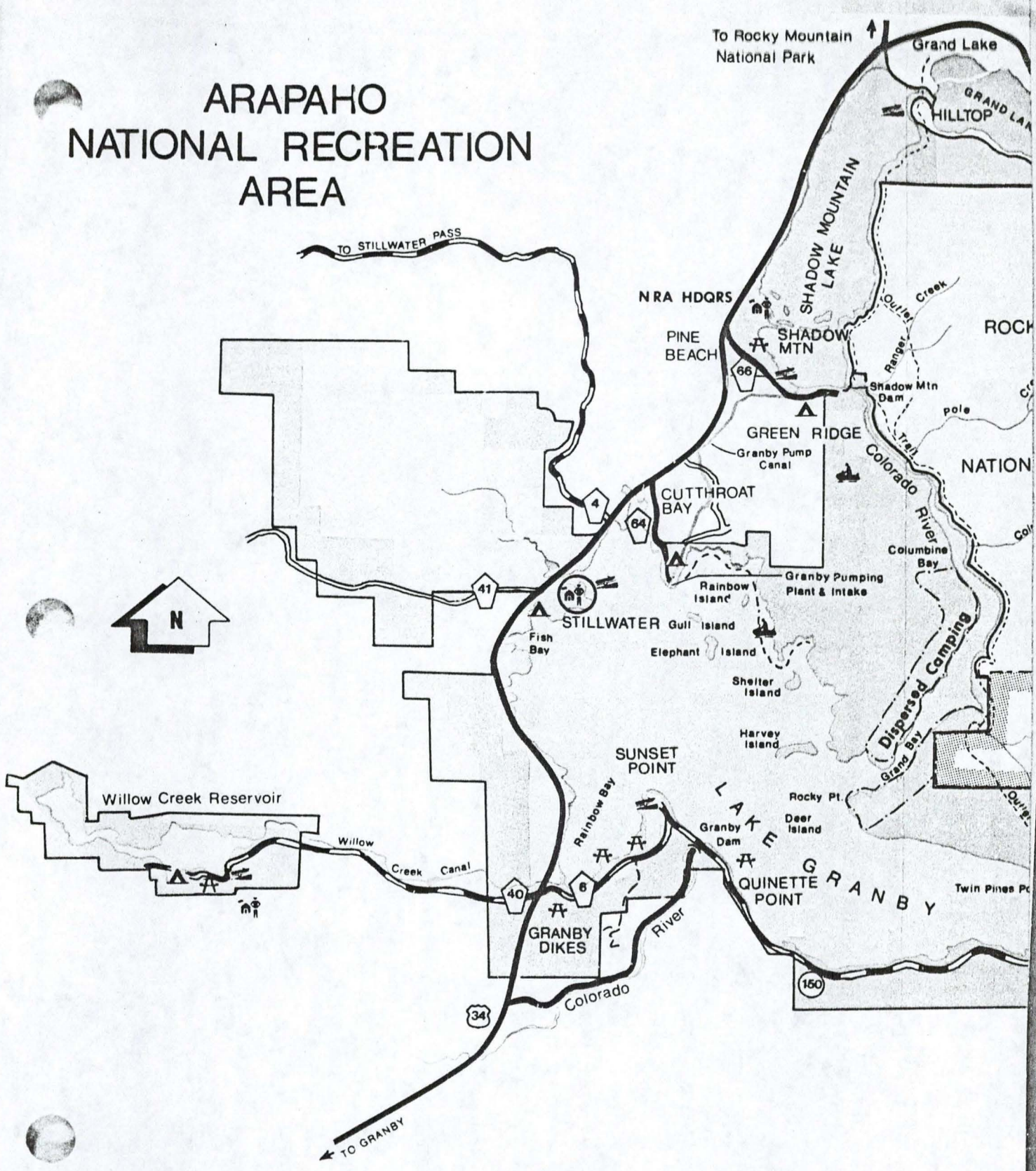
MILEAGE TABLE

MILEAGES BASED ON SUMMERTIME TRAVEL

	GOLDEN	GRAND JUNCTION	GREELEY	GUNNISON	HOLYOKE	HOT SULPHUR SPRINGS	HUGO	IDAHO SPRINGS	JULESBURG	KIOWA	LA JUNTA	LAKE CITY	LAMAR	LAS ANIMAS	LEADVILLE	LIMON	LITTLETON	LONGMONT	LOVELAND	MEEKER	MONTE VISTA	MONTROSE	RAWLINS
WOOD SPRINGS	298																						
GOLDEN	126	247																					
GRAND JUNCTION	416	143	365																				
GREELEY	213	122	[illegible]	246																			
GUNNISON	351	14		198																			
HOLYOKE	214	[illegible]		62	137																		
HOT SULPHUR SPRINGS	427	15-		[illegible]	275	181	213																
HUGO	298	105	223	199	146	60	84	211															
IDAHO SPRINGS	350	227	224	253	268	113	206	265	142														
JULESBURG	163	302	55	420	262	310	240	431	284	267													
KIOWA	405	251	279	199	300	102	238	230	161	56	322												
LA JUNTA	369	246	243	232	286	123	225	263	160	19	286	37											
LAKE CITY	178	153	118	271	91	206	69	282	153	220	173	275	239										
LAMAR	335	134	239	156	183	16	121	167	44	98	294	117	117	190									
LAS ANIMAS	255	62	192	180	103	104	41	191	45	166	247	206	185	110	88								
LEADVILLE	282	35	231	170	104	135	67	182	58	210	286	237	229	137	120	46							
LIMON	296	21	245	164	101	150	82	175	103	225	300	252	244	151	135	60	18						
LITTLETON	304	280	230	402	159	330	191	412	277	357	266	413	376	138	314	235	263	260					

Printed by A. B. Hir
Denver, Colora

ARAPAHO NATIONAL RECREATION AREA



FACILITIES	Camp Units	Picnic Units	Drinking Water	Toilets	Boat Ramp	Amphitheater	Ranger Station	Visitor Information Service	Trailer
Hilltop				x	x				

LEGEND

O
AL
TION

ea (NRA) is
the upper
ley. It was
11, 1978,
rvice, U.S.
ie area was
NRA ad-
vice.

,000 acres
e Granby,
ake, Willow
Reservoir.
lake in
, northeast

A (Shadow
low Creek
red valleys
the rolling
lebris and
e lakes are
which are
ck left by
the area is
r Tertiary

spen grow
e and fir on
in the area
red fox,
adger, pine
er.

Mountain
nade reser-
and Lake.
at Lakes of
Thompson
ministered

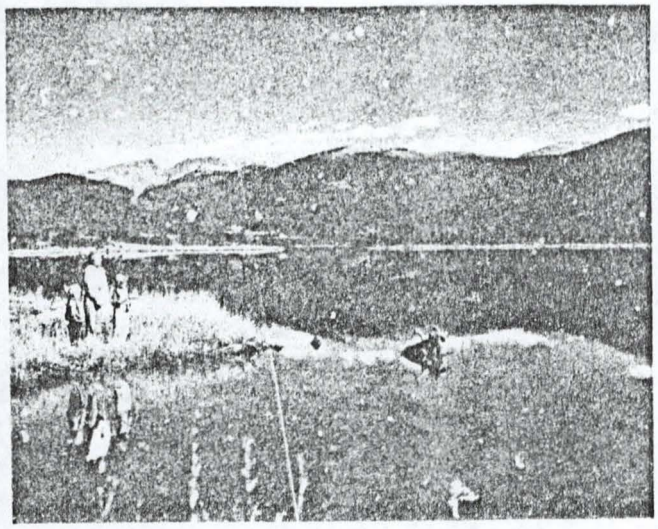
NG Hiking,
tivities may
n be rented

The Colorado-Big Thompson Project diverts water from the Colorado River Valley on the western slope of the Continental Divide to the Big Thompson River drainage of the eastern slope. The lakes in the NRA store water that flows through the 13.1 mile-long Adams Tunnel. The tunnel originates at the east end of Grand Lake, passes beneath the great peaks of Rocky Mountain National Park, and emerges a few miles south of the town of Estes Park. Hydroelectricity, irrigation water, and domestic water for northeastern Colorado are the major benefits of the diversion project.

The Arapaho NRA is managed by the Forest Service to provide public recreation and enjoyment; to conserve and develop scenic, natural, historic, and pastoral values; to manage and utilize natural resources including water quality.

Recreation facilities in the NRA include four developed campgrounds with 340 overnight camping spaces, six public boat launching ramps, eight picnic areas, and 14 miles of hiking trails. All of these facilities open to the general public about May 15, weather permitting.

In addition, there are 11 marinas and four cafes in the NRA open to the public. These are privately owned and are operated under permit from the Forest Service.



WINTER USE The Arapaho NRA and surrounding lands are popular sites for snow-

WHAT TO DO

BOATING Rowboats, canoes, sailboats, and motorboats can be rented at most of the marinas. Free public boat ramps are located at Willow Creek Reservoir; Hilltop and Green Ridge on Shadow Mountain Lake; and Stillwater, Sunset Point, and Arapaho Bay on Lake Granby. Arrangements also can be made to launch boats at marinas.

Boats on Willow Creek and Meadow Creek Reservoirs are limited to 16 feet or less in length with motors of not more than 10 horsepower. No motorized boats are allowed on Monarch Lake. Information on boating regulations and water hazards can be obtained from NRA personnel or boat patrol rangers.

There are sailing regattas most weekends throughout the summer season on Lake Granby and Shadow Mountain Lake.

WATER SPORTS There are no designated swimming areas on the lakes. Although water temperatures are cold, water skiing is a popular activity on Lake Granby and Shadow Mountain Lake.

FISHING The waters of the NRA are open to fishing year-round, subject to Colorado regulations. A Colorado fishing license is required. Licenses and regulations can be obtained at most sporting goods stores in the towns of Granby and Grand Lake. Rainbow, mackinaw, brown, native and brook (trout) and kokanee (landlocked sockeye) salmon are found in Lake Granby and Shadow Mountain Lake. Rainbow and brown trout are in the other lakes.

Appendix B

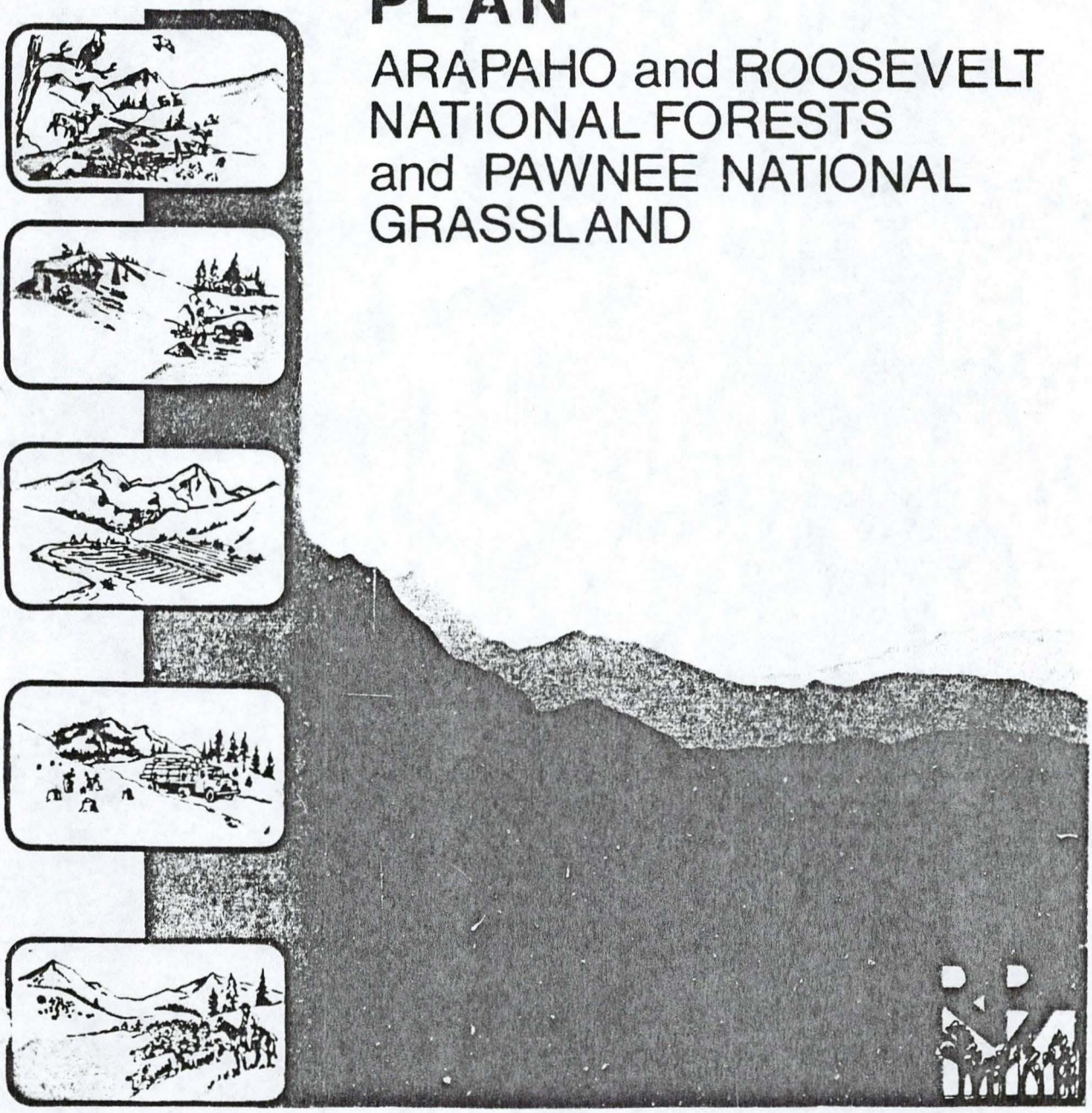
United States
Department of
Agriculture

Forest Service

Ft. Collins, Colorado

LAND and RESOURCE MANAGEMENT PLAN

ARAPAHO and ROOSEVELT NATIONAL FORESTS and PAWNEE NATIONAL GRASSLAND



The goals of the Forest Plan are:

Vegetation Diversity

- Encourage natural succession to proceed in all designated wilderness and natural areas.
- Manage all vegetation types outside of wilderness to provide vegetation diversity, provide resource benefits to replace natural processes where fire and insect and disease outbreaks have been eliminated or controlled due to human activity.
- Improve the health and vigor of all vegetation types to be resistant to insect and disease.
- Schedule vegetation treatments for the greatest number of recreation, wildlife, range, water, and timber goals as specified by each management area.

Recreation and Cultural and Visual Resources

- Recognize the significance of recreation in proximity to the Front Range population and national attractions.
- Provide a broad range of dispersed and developed recreation opportunities by providing areas for high density (large number of people) and separate areas for low density (limited contact) use.
- Close most newly constructed roads to public motorized use unless they occur where motorized use is emphasized.
- Provide areas and increased capacity for nonmotorized recreation opportunities by closing most newly constructed local roads and some of the existing road system.
- Provide intensive management of motorized recreation on high quality areas and locations available today.
- Construct new trails and trailheads in areas that can sustain and maintain the desired experience. Ensure roads closed to motorized traffic will be available as trails.
- Provide the opportunity for developed recreation sites to be operated by public concessionaires.
- Provide more cost-effective service in developed recreation sites.
- Provide added developed recreation capacity only where demand already exists and private sector cannot meet the demand.
- Place priority on restoration of existing facilities presently below standards in order to charge fees before new construction.
- Provide opportunities for maintaining and expanding downhill skiing.

- Locate, determine the significance of, and where appropriate, preserve historical and archaeological sites.

- Manage exceptional historical and archaeological sites for increased public use and visitation, while still protecting the values of the site.

- Make historical and archaeological sites available for study by agencies involved in research.

- Maintain, enhance, and/or restore visual resources in visually sensitive areas.

- Design interpretive service programs to resolve management problems, reduce management costs, obtain visitor feedback, increase public understanding of Forest Service management, and provide safe use of the Forest.

Wilderness

- Manage wilderness to preserve the wilderness character in accordance with the Wilderness Act of 1964 and the Colorado Wilderness Act of 1980.

- Provide a range of wilderness experiences from areas with high use levels and limited opportunity for solitude, to areas with very low use levels and excellent opportunities for solitude.

- Prevent decline in physical and biological resource conditions and reduce user conflicts.

- Restore areas showing evidence of unacceptable physical and biological impacts of past use.

- Increase visitor awareness and improve behavior related to maintenance of wilderness values.

Wildlife and Fish

- Recognize the need to provide wildlife habitat in areas where wildlife populations are stressed through habitat loss, migration route disruption and harassment by people and dogs.

- Improve fish habitats and manage wildlife habitats to maintain viable populations of native species and to maintain and improve habitat of management indicator species.

- Protect and enhance riparian habitat for wildlife.

- Provide for diversity of plant and animal communities by working toward the desired size class distribution of forest vegetation types.

- Increase winter range carrying capacity for deer, elk, and bighorn sheep.

- Manage endangered and threatened plant and animal species to population sizes and distribution where they are no longer threatened, in cooperation with other State and Federal Agencies.

- Improve habitat effectiveness and minimize disturbance to wildlife whenever consistent with management area goals.

- Perpetuate the aspen type.

Range

- Provide for improvement of deteriorated rangeland.

- Provide for grazing of livestock at moderately increased levels.

- Provide for intensive livestock management on the Pawnee National Grassland.

Timber

- Provide commercial timber sales of sufficient quantity and quality to maintain the timber industry needed to accomplish desired vegetation treatment goals.

- Meet as much of the demand for wood fiber as possible within the multiple-use constraints.

- Provide fuelwood opportunities consistent with encouraging private sector supplies through use fees and provision of a stable supply of small diameter material.

- Eliminate the reforestation backlog by the end of 1985.

- Maintain a healthy forest by applying appropriate silvicultural treatments.

- Implement appropriate silvicultural practices support by site-specific inventory data and management area goals.

Soils and Water

- Protect soil and water productivity so that neither will be significantly or permanently impaired for all activities on National Forest land.

- Protect streams, lakes, wetlands, and other bodies of water.

- Protect the riparian vegetation along and around all perennial streams, lakes, and other bodies of water.

- Recognize the value of water for the future of western states.

MANAGEMENT ACTIVITIES	GENERAL DIRECTION	STANDARDS & GUIDELINES
CONTINUATION OF: Visual Resource Management (A04)	4. Plan, design and locate vegetation manipulation in a scale which retains the color and texture of the characteristic landscape, borrowing directional emphasis of form and line from natural features. (0365)	a. Meet the Visual Quality Objectives of retention and partial retention one full growing season after completion of a project. Meet modification and maximum modification objectives three full growing seasons after completion of a project. (6259)
		b. Determine sensitivity levels in accordance with FSH 2309.16, Agriculture Handbook No. 462, Vol. 2, Chapter 1, Sensitivity Levels. (6272)
	5. Blend soil disturbance into natural topography to achieve a natural appearance, reduce erosion and rehabilitate ground cover. (0366)	
	6. Revegetate disturbed soils. In large projects, this may have to be done in stages. (0456)	a. Revegetate disturbed soils by the following growing season. (6276)
	7. Choose facility and structure design, color of materials, location and orientation to meet the adopted visual quality objective(s) for the management area. (0367)	
Recreation Site Construction and Rehabilitation (A05 AND 06)	1. Provide appropriate development facilities where the private sector is not meeting the demand. (0441)	
	2. Maintain cost-effective developed recreation facilities which complement non-Forest Service developments. (0442)	a. Provide, in new recreation experience level 3 and level 4 sites and reconstructed sites of more than 125 PAOT capacity, at least 10 percent of the units for use by the physically limited. Consider, where site conditions permit such consideration, the needs of the physically limited in toilet design

MANAGEMENT ACTIVITIES	GENERAL DIRECTION	STANDARDS & GUIDELINES
CONTINUATION OF: Recreation Site Construction and Rehabilitation (A05 AND 06)		in such developed sites. (6511AR)
	3. Provide facilities which are accessible to handicapped persons. (0443)	
	4. Facilities proposed for construction or reconstruction which lie within identified 100-year floodplains will be evaluated as to the specific flood hazards and values involved with the site. Viable alternatives will be thoroughly evaluated. (0728)	a Follow procedures and guidelines in FSM 2527.04c (6632)
	5. Past and probable flood heights in inventoried 100-year floodplains will be posted to provide visible warnings to the using public about possible periodic flooding. (0730)	a Follow procedures and guidelines in FSM 2527.6 (6634)
Management of Developed Recreation Sites (A08, 09, 11 & 13)	1. Design, construct and operate developed sites which are adjacent to or provide an access point into a wilderness to complement wilderness management objectives. (0350)	
	2. Construct, reconstruct and maintain developed sites in accordance with the established Recreation Opportunity Spectrum (ROS) classification for the management area. (0348)	a Standards and Guidlines ROS Class* / Site Development Scale** P: Not to exceed 1 SPNM: Not to exceed 2 SPM: Not to exceed 2 RN: Class 3 or 4 R: Class 3 or 4 U: Class 5 * P = Primitive, SPNM = Semi-primitive non-motorized

FOREST DIRECTION

MANAGEMENT ACTIVITIES	GENERAL DIRECTION	STANDARDS & GUIDELINES
CONTINUATION OF: Management of Developed Recreation Sites (A08, 09, 11 & 13)		SPM = Semi-primitive motorized RN = Roaded Natural R = Rural U = Urban ** FSM 2331.47 (6193)
	3. Manage development scale 3 and 4 sites for full service when at least one of the following are met: a. A campground is designated as a fee site; b. More than 20 percent of theoretical capacity is being utilized; c. A group campground or picnic ground has a reservation system and/or user fee; or d. The site is a swimming site, a boating site with a constructed ramp, or a staffed visitor information center. (0349)	a. FSM 1310 R2 ID No. 1 7/22/82 (6194) b. Manage for optimum use of campgrounds and picnic areas (40 percent of theoretical capacity or an average of 80 percent of units occupied each day during the managed use season by parties averaging 3.5 persons). Do not permit use to exceed design capacity by more than 10 percent at any time. (6505AR)
Dispersed Recreation Management (A14 and 15)	1. Provide a broad spectrum of dispersed recreation opportunities in accordance with the established Recreation Opportunity Spectrum (ROS) classification for the management area. (0351)	
	2 Close or rehabilitate dispersed sites where unacceptable environmental damage is occurring. (0040)	a. Close sites that cannot be maintained in Frissell Condition Class 1, 2, or 3 (Campsite Condition, Frissell, S.S.; Journal of Forestry August 1978). (6023) b. Rehabilitate sites in Frissell condition classes 4 and 5. (6517AR) c. Campsite condition class based upon Frissel, S.S.; Journal of Forestry, May, 1978 (6278)

FOREST DIRECTION

AREA-SPECIFIC IMPLEMENTATION PROGRAM
ARAPAHO NATIONAL RECREATION AREA

I. INTRODUCTION

This area-specific implementation program contains the specific management direction for the Arapaho National Recreation Area and prioritizes management actions. It interprets both the forest-wide direction and the management area prescriptions in the Arapaho and Roosevelt National Forest Land and Resource Plan. The decisions and priorities within activities reflected in the implementation program are based on analyses, inventories, and involvement with a wide range of public and private organizations and research conducted since 1978. Documentation is contained in the "Interim Management Plan for the Arapaho National Recreation Area", approved September 7, 1979, as well as in various working papers, analyses, and studies contained in public files at the Forest Supervisor's and District Ranger's offices.

This implementation program will be the basis for developing the annual program of work. The annual program of work will necessarily reflect variations from the action program based on variations in budget levels which are beyond the forest's control.

Briefly, the implementation program is designed to achieve the Forest Plan goals and those stated in the enabling legislation for the Arapaho National Recreation Area.

PL95-450 which created the Arapaho National Recreation Area, directs the Secretary of Agriculture to administer the area to best provide for:

A. "Public recreation and enjoyment;

B. The conservation and development of the scenic, natural, historic, and pastoral values of the area;

C. The management, utilization, and disposal of natural resources such as timber, grazing, and mineral resources so that their utilization will not substantially impair the purposes for which the recreation area is established; and

D. The management of water quality in the recreation area consistent with the development of needed water supply and waste water systems, including the control of aquatic vegetation in the streams. lakes, and reservoirs within the recreation area".

The implementation program consists of the following parts:

A. A map of management areas based on the Forest Plan allocation to management prescriptions, and a description of the objectives of the allocation.

III. SUMMARY OF MANAGEMENT DIRECTION

The management direction for the Arapaho National Recreation Area was developed to respond to the following:

1. Address and correct health and safety concerns and problems.

2. Accomplish activities in a manner consistent with the mandates of PL 95-450 and other Forest Service policies and directions.

3. Accomplish rehabilitation, expansion, and new construction to meet projected demands based on priorities established in the Forest Plan.

4. Establish public information activities directed toward safe enjoyment by the user and to facilitate management activities.

The Management Direction is summarized as follows:

1. Permit existing marinas and bring to standard in 5 years.

2. Will not consider applications for new marinas but may issue a prospectus if demand analysis indicates needs.

3. Will permit association docks based on demand.

4. Individual permits for private docks will be continued and new permits for individuals with lake shore property will be considered.

5. Non-docking structures such as porches and decks will not be allowed to extend over the water surface.

6. Manage Willow Creek, Meadow Creek, and Monarch reservoirs for a non-developed recreation experience, by maintaining the absence of manmade structures on the water surface and protecting the shoreline integrity.

7. No overnight camping on islands.

8. Construct 18 miles of new trails.

9. Provide for winter recreation activities.

10. Rehabilitate existing developed units to standard and schedule.

11. Increase developed site capacity by 465 camp units, 46 picnic units, and 125 day use parking spaces.

12. Maximize the use of Twin Creek cabin for administrative purposes and prevent its deterioration.

13. Acquire lands as specified and consider certain lands for disposal, to achieve the objectives of this plan.

14. Review withdrawals from mineral entry to identify new withdrawals necessary to protect NRA values and relinquish those where the surface can be protected under existing regulations.

15. Transportation system analysis and development will be commensurate with the resource needs as they develop or change.

16. The administrative office for the ANRA is the Sulphur District office and will be located in the Granby area. Locate a District work center within a convenient distance of the office and field work projects.

17. Permit lake shore owners to dredge on Granby and Shadow Mountain, on a case by case basis to achieve the objectives of this program.

18. Maintain healthy vegetative cover.

19. Provide information programs which maximize outputs at minimum costs.

In the following sections, the general management direction statement is followed by a description of how it applies to the nine National Recreation Area management areas.

IV. MANAGEMENT DIRECTION, EXPECTED RESULTS, AND MAJOR PLANNED ACTIONS REQUIRED

A. Water Surface Management

1. Marinas

A marina is defined as an on-water boat storage facility which provides any combination of the following services to the public:

- On-water boat storage
- Launching services
- Fuel sales
- Marine repair services
- Boat rentals
- Rental or sale of marine supplies, ice, and related recreation equipment.

a. Direction: Permit existing marinas to continue operations which provide for the public demand for storage and services.

Application to Management Areas

1A-1	1A-2	1D	2A	2B	3A	4B	5B	6B
No	No	No	No	Yes	No	No	No	No

Expected Results

Results in four marinas on Shadow Mountain Reservoir and five on Lake Granby.

Appendix C

Soil Vegetative
Management Units

Soils

There are two major soil types associated with the Stillwater Campground in the Arapaho National Recreation Area (ANRA). The Leavitt soil is deep, and well-drained, and found on fans and terraces. It formed in local alluvial material weathered from sedimentary rock. This soil usually supports grass-forb-shrub habitat types.

The Uinta soil is also deep and well-drained and occurs on the upper slopes and ridges. It formed in glacial drift and material weathered from metamorphic rock. This soil typically supports forest habitat-types.

The average annual precipitation for the ANRA is about 16-20 inches, the average annual air temperature is 39° F, and the fros-free season is about 35 to 55 days. Elevation is approximately 8350 feet. Slopes range from 0 to 35 percent.

The mean precipitation April through September is only 8 to 10 inches. This is the principle period for plant growth, contributing to the low natural productivity of these soils within the campground.

Existing Conditions

Both soil types are suited to developed campground sites, however, a combination of intensive sustained recreation use, poor campground design and lack of maintenance has led to a decline in the soil productivity and hydrologic function throuhout the area. Loss of soil productivity and hydrologic function (the ability of the soil to handle internal and external drainage), has led to a substantial reduction in plant growth, plant reproduction, and an acceleration of on-site soil loss.

Specific environmental impacts to the soils and vegetation are severe soil compaction and discplacement of the litter layer and soil surface horizon. Compaction of the soil particles lowers the soil's ability to transmit water and air through the soil, reducing the available water holding capacity of the soil. Plant roots ahve difficulty penetrating through the compacted layers of the soil to utilize what water is available.

Precipitation or snowmelt tends to "pond-up" or remain at or on the compacted soil surface and typically leaves the site as overland flow or surface runoff. Accelerated surface runoff loosens the litter layer and surface horizons, accelerating on-site erosion. Campground areas disturbed by

uncontrolled foot traffic and site levelling are particularly susceptible to soil loss. Manipulation of the land surface has created channelized drainage patterns creating rills and gullies.

Sites developed on slopes greaer than 8 percent are an indication of poor site design. These sites tend to erode very rapidly exposing tree roots and concentrating overland flow and reducing or eliminating the use and capacity of the sites.

Management Objectives

Soils and vegetation within the Stillwater Campground are impacted so extensively, they have exceeded the ability to recuperate naturally, even with complete non-use. Therefore, restoration of the soil productivity and hydrologic function within Stillwater Campground should be an integral component of the rehabilitative vegetation management plan. Successful establishment of shrubs, trees, forbs and grasses will require stabilization of soil erosion, improvement of soil productivity, modification of campground design, and development of a maintenance plan. Stabilization of soil erosion and improvement of soil productivity will require:

1. Improved soil infiltration (breaking compacted soil layers)
2. Improved soil fertility (addition of soil amendments)
3. Establishment of effective ground cover
4. Establishment of young plants (reproduction)
5. Stabilization of on-site soil erosion
6. Control of human use patterns
7. Follow-up maintenance in post-treatment years
8. Modification of site design

Of the two soils associated with Stillwater Campground, the Uinta soil associated with coniferous habitat-types will require more intensive management to establish and maintain vegetative productivity. The Uinta soil in undisturbed conditions has a moderately low productivity. Establishment, improvement, and maintenance of forbs, shrubs and trees will require moderately intensive management techniques. However, establishment of grasses and grass-like plants will be very difficult, requiring intensive management and maintenance.

Recommendations

Recommendations for achieving soil productivity management objectives are addressed by vegetative management units 1 through 6, established in Stillwater Campground for analysis of management needs.

The Leavitt soil associated with grass-shrub plant communities will also require moderately intensive management practices such as ground leveling, planting, fertilization, and irrigation in order to establish and improve vegetation on disturbed sites. All the Leavitt soils will be analyzed under one vegetative management unit, #7.

VEGETATIVE MANAGEMENT UNITS

Vegetative Management Unit #1

This unit is located on the Uinta sandy loam soil on slopes generally greater than 8 percent. Slopes greater than 8 percent are not well suited for developed campgrounds. Consequently, about 25 percent of the land in unit #1 has active accelerated soil erosion. Soil erosion is most severe up- and downslope from the toilet facilities where rills and gullies have formed. Up to 5 inches of top soil has been lost from some areas. Soil compaction, due to uncontrolled foot traffic and poor site design has reached a critical growth-limiting point on at least 35 percent of unit #1 (roots can no longer penetrate the soil for necessary water and nutrients.).

Together the soil erosion and soil compaction has caused an extensive loss of ground vegetation and loss of the protective forest litter layer, and permanent suppression of forest regeneration.

Natural recovery of soil productivity is doubtful without total closure of the area. Intensive cultural and managerial practices will be important in site restoration without losing use and capacity.

Prescription - Stabilize soil productivity and prevent further decline in site productivity by implementing erosion control measures, improving soil fertility, reconstructing and modifying site design, and lowering existing PAOT site capacity.

1. Contain and eliminate soil erosion on at least 95 percent of disturbed areas through such measures as:

   a. Site leveling, site design modification, and surfacing of tent pads, parking spurs and other intensively used areas.

   b. Reducing existing PAOT capacity.

   c. Controlling surface runoff patterns through measures such as installation of water bars, check dams, terraces, lined ditches, and vegetation placement.

   d. Implementing immediate measures to restore effective ground cover on disturbed soils through site preparation, seeding with grass-mix species, fertilization, application of erosion control fabric and irrigation. 1/

2. Eliminate soil compaction within unit #1 by 95 percent.

   a. Mechanically break up compacted soil horizons at least 7 inches in depth. Accomplish in conjunction with site preparation for seeding and planting. 2/

   b. Define and surface trails - use physical barriers to control foot traffic.

3. Restore effective ground cover on at least 80 percent of bare areas (excluding designated sites and trails). See Table I and II for desired effective ground cover combinations.

   a. See (d) under "containing soil erosion," for short-term measures.

   b. Underplant trees and shrubs where natural regeneration is lacking and where vegetation is needed for long-term slope and soil stabilization.

   c. Implement steps (a) and (b) as deemed necessary in patchcuts of thinned stands. (See Timber section).

Vegetative Management Unit #2

This unit is located on the Uinta soil on slopes ranging from 2 to 20 percent. About 25 percent of this unit has active soil erosion, with loss of topsoil 1 to 2 inches. Soil erosion is most prevalent in campsites located on oversteepened slopes and around the toilet facilities where rills and gullies have formed. Cut bank erosion along the road includes gullies up to 3 feet deep. Soil compaction has reached the critical growth-limiting point on at least 20 percent of this unit with another 20 percent of the area moderately compacted. Reproduction of the overstory is evident but limited in extent. The understory vegetation is in a slight downward trend. Potential site productivity on about 20 percent of the soils has been reduced below the natural recuperative capacity. PAOT site potentail has dropped below desired site capacity and may have to be temporarily adjusted downward until site is considered stabilized.

Prescription - Stabilize soil productivity on all disturbed portions of the unit, to a near natural potential. Reduce PAOT capacity to a lower level until site productive capacity is considered restored.

1. Contain and eliminate soil erosion on a 95 percent of disturbed areas through such measures as:

   a. Site leveling, site design modifications, and surfacing of tent pads, parking spurs and other intensively used areas.

   b. Reducing existing PAOT capacity.

   c. Controlling surface runoff patterns through measures such as installation of check dams, water bars, lined ditches, and vegetation placement.

   d. Implementing immediate measures to restore effective ground cover on disturbed soils through site preparation, seeding with grass-mix species, fertilization, application of erosion control fabric and irrigation.

   e. Define trails from roads to toilet facilities to avoid gully erosion on cutbanks. This may require stairs or steps.

   f. Plug all gullies.

2. Eliminate soil compaction by 95 percent.

   a. Mechanically break-up compacted soil layers to a 7 inch depth. Accomplish in conjunction with site perparation, planting and seeding as per planting guides (see ltr of 6-22-84; 2330).

3. Restore effective ground cover on at least 80 percent of bare areas (excluding designated sites, trails, roads, etc). See Tables I and II for desired effective ground cover combinations.

   a. See (d) under "containing soil erosion" for short-term measures.

   b. Underplant trees and shrubs where natural regeneration is lacking and where vegetation is needed for long-term slope and soil stabilization (i.e., eroding cutbanks).

   c. Follow (a) and (b) where needed in patchcuts and thinned stands.

Vegetation Management Unit #3

This unit is located mainly on the Uinta soil with the very northeast portion on the Leavitt soil. Slopes typically range from 5 to 40 percent. Approximately 60 percent of this unit has active soil erosion with topsoil loss exceeding 7 inches in depth. A combination of oversteepened slopes and heavy cross foot-traffic has devastated the hillside surrounding the toilet facilities and the banks adjacent to the shoreline. Gully and rill erosion is extensive. soil erosion throughout the campsites has been aggravated by uncontrolled surface runoff from the main campground road. This problem is caused by poor road alignment. Soil compaction has reached the critical growth limiting point on about 80 percent of the area.

Soil productivity has been permanently reduced below the natural potential capacity. PAOT site has also been reduced below natural potential capacity. Existing campsite design is incongruous to the steep slopes and close proximity to the shoreline.

Major biotechnical shore protection and erosion control measures should be considered in conjunction with conceptual site design modifications within unit #3.

Prescription - Recommendations are to restore soil productivity by stabilizing soil erosion, eliminating soil compaction, and establishing effective vegetation ground cover. Conceptualize measures for slope protection and erosion control along the shore. Reduce the existing PAOT site capacity to reflect a permanent loss of soil-site productivity and necessary site design modifications.

1. Contain and eliminae soil erosion on 95 percent of the unit #3 through such measures as:

   a. Implementing conceptual design changes to level sites, parking spurs, and hard-surface sites. Reduce total number of sites at least by two.

   b. Repairing slope below toilet; defining trail from toilet to beach with stairs and/or steps; re-shaping slope by terracing or contouring; installing gully plugs; and check dams.

   c. Providing lined ditch or channel for surface runoff from toilet to shore or disperse runoff away from disturbed slopes and high-use areas

d. Redesigning road with inslope to inside ditch. Install culvert under the road to surfaced or lined channel.

e. Implementing immediate measures to restore effective ground cover on disturbed soils through site preparation, seeding with grass-mix species, fertilization, application of erosion control fabric and irrigation.

2. Eliminate soil compaction by 95 percent.

a. Mechanically break up compacted soil horizons at least 7 inches in depth. Accomplish in conjunction with site preparation and planting.

3. Restore effective vegetative ground cover on at least 90 percent of bare areas, (excluding designated sites, trails, and roads, etc). See Table I and II for desired effective ground cover combinations.

a. See (d) under "Contain soil erosion" for short-term measures.

b. Follow-up with underplantings of trees and shrubs where natural regeneration is lacking and vegetation is needed for long-term slope and soil stabilization.

c. Follow steps (a) and (b) where needed in patchcuts or thinned stands.

d. Define patterns of use through the unit by means of surfaced trails, vegetative barriers, and/or physical barriers.

Vegetative Management Unit #4

Description

The soils associated with this unit are considered Uinta soils, however, they are slightly different from the typical Uinta sandy loam. Soil textures are slightly finer, the erosion hazard is slightly higher and the site index is slightly lower. This site is a "transition" zone between forest plant communities and sagebrush communities.

Soil erosión is active on about 20 percent of this unit, and is associated with trails around the toilet facilities, trails along the shore, the shoreline itself and sites located on slopes greater than 5 percent. The overstory is

sparse in part due to the inherent productivity of the site. Natural regeneration appears to be in a downward trend. Soil compaction is associated mainly with immediate perimeter of campsites.

Prescription - Recommendations are to restore site productivity by stabilizing soil erosion, stabilizing the shoreline and defining user trails. Supplement overstory regeneration through underplanting with trees and shrubs.

Recommendations - Restore soil-site production through erosion control, slope protection and establishment of effective vegetative ground cover.

1. Contain and eliminate soil erosion on 95 percent of this unit through such measures as:

   a. Implementing conceptual design changes for site leveling and site surfacing.

   b. Implementing shoreline stabilization measures.

   c. Controlling surface runoff through measures such as installation of water bars, check dams; terraces, lined ditches and culverts.

d. Implementing immediate measures to restore effective ground cover on disturbed soils through site preparation, seeding with grass-mix species, fertilization, application of erosion control fabric and irrigation.

2. Eliminate soil compaction within unit #4 by 95 percent.

   a. Mechanically break up soil horizons at least 7 inches in depth. Accomplish in conjunction with site preparation for seeding and planting.

3. Restore effective vegetative ground cover on at least 90 percent of bare areas (excluding designated trails, sites, roads, etc.). See Table I and II for desired effective ground cover combinations.

   a. See (d) under "Contain soil erosion" for short-term measures.

   b. Plant trees and shrubs around perimeter of campsites to establish reproduction where natural is lacking and where vegetation is needed for long-term slope stabilization.

c. Implement steps (a) and (b) as needed in patchcuts or thinned stands.

Vegetative Management Unit #5

Description

This unit is found on the Uinta soil which supports a coniferous forest habitat type. Slopes range from 4 to 20 percent. The major use on this unit is related to campsites and toilet facilities. Soil erosion is active on 60 percent of this management unit. The most extensive soil erosion is occurring on campsites 87, 89 and 90 and has decreased at least on one site. Soil loss averages 1/10 to 1/8 of an inch in a year. Soil compation is near the growth-limiting critical point on about 30 percent of the unit. Soils near the water tower have slightly coarser textures than the typical Uinta soil, with slightly higher understory and overstory loss of reproduction. Natural recuperative capacity of site productivity within this unit is doubtful.

Prescription

Stabilize soil-site productivity and prevent furhter decline in site productivity. Implement erosion control measures, improve soil fertility, and restore effective vegetation ground cover. Implement site design changes, facilities

modification and reduce existing PAOTs. Realign the loop on the main campground road.

1. Contain and eliminate soil erosion on at least 95 percent of disturbed areas through such measures as:

   a. Installation of culverts, ditches, etc.--to accommodate surface runoff from existing roads and disperse away from adjacent campsites.

   b. Site leveling, site design modification, and surfacing of tent pads, parking spurs and other intensively used areas.

   c. Reducing existing PAOT capacity at least by two sites.

   d. Controlling surface runoff patterns through measures such as installation of water bars, check dams, terraces, lined ditches, and vegetation placement.

   e. Implementing immediate measures to restore effective ground cover on disturbed soils

through site preparation, seeding with grass-mix species, fertilization, application of erosion control fabric and irrigation.

2. Eliminate soil compaction within unit #5 by 95 percent.

   a. Mechanically break up compacted soil horizons at least 7 inches in depth. Accomplish in conjunction with site preparation for seeding and planting.

   b. Define and surface trails - use physical barriers to control foot traffic.

3. Restore effective ground cover on at least 80 percent of bare areas (excluding designated sites and trails). See Table I and II for desired effective ground cover combinations.

   a. See (d) under "Containing soil erosion," for short-term measures.

   b. Underplant trees and shrubs where natural regeneration is lacking and where vegetation is needed for long-term slope and soil stabilization.

c. Implement steps (a) and (b) as deemed necessary in patchcuts or thinned stands. (See Timber section).

Vegetative Management Unit #6

Description

This unit is located on the Uinta soil which supports a forest habitat-type. Approximately 40 percent of this unit has active soil erosion. Soil productivity has decreased at least one site class and is beyond natural recuperative capacity. Soil compaction is near the critical growth-limiting threshold on about 30 percent of the area, usually in combination with eroded portions of the unit. Most disturbance is associated with uncontrolled foot traffic, use of toilet facilities and campsites. Loss of effective ground cover is a major impact, contributing to the decline in site productivity. This unit has lost its natural recuperative capacity to restore the site to its potential productivity.

Prescription - Stabilize soil productivity on all disturbed portions of the unit, to a near natural potential. Reduce PAOT capacity to a lower level until site productive capacity is considered restored.

1. Contain and eliminate soil erosion on a 95 percent of disturbed areas through:

   a. Site leveling, site design modifications, and surfacing of tent pads, parking spurs and other intensively used areas.

   b. Reducing existing PAOT capacity by one site.

   c. Controlling surface runoff patterns through measures such as installation of check dams, water bar lined ditches, and vegetation.

   d. Implement immediate measures to restore effective ground cover on disturbed soils through site preparation, seeding grass-mix species, fertilization, application of erosion control fabric and irrigation.

2. Eliminate soil compaction by 95 percent.

   a. Mechanically break up compacted soil horizons at least 7 inches in depth. Accomplish in conjunction with site preparation for seeding and planting.

3. Restore effective ground cover on at least 80 percent of bare areas (excluding designated sites and trails). See Table I and II for desired effective ground cover combinations.

   a. See (d) under "Contain soil erosion."

   b. Underplant trees and shrubs where natural vegetation is lacking and where vegetation is needed for long-term slope and soil stabilization.

   c. Implement steps (a) and (b) as deemed necessary in patchcuts or thinned stands.

Vegetative Management Unit #7

Description

This unit includes all areas of Stillwater campground on the Leavitt soils which is primarily associated with the sagebrush plant community. The Leavitt soils are more erodible than the Uinta soils. Campsite and facility development should be limited to slopes less than 5 percent. All new proposed sites should be surfaced to prevent soil erosion. Soil erosion in this unit is most evident along

road cutslopes and along defacto trails. Soil disturbance associated with campsites is severely impaired. Trails across unit #7, from upper loop road to the shore are channeling surface runoff, creating shallow gullies. Trail stabilization is recommended to prevent major gully development.

Proposals to dismantle the amphitheater should include "immediate slope" shaping and vegetative restoration plans to stabilize the site.

Prescription - Recommendations for this unit are to stabilize existing soil erosion and enhance the health of the vegetation and soils where possible through pre-planned site and trail modifications. Level all campsites located in the sagebrush plant community and surface tent pads, trails and parking spurs.

1. Contain and eliminate soil erosion on 95 percent of this unit through such measures as:

    a. Implementing immediate measures to restore effective round cover on disturbed soils through site preparation, seeding with grass-mix species, fertilization, application of erosion control fabric and irrigation.

b. Implementing immediate rehabilitation of disturbed soils upon removal of amphitheater facilities.

c. Designating permanent trail system through the sagebrush community and installing waterbars or check dams along the trail to divert runoff.

d. Designing biotechnical shore protection measures to stabilize eroding shoreline where needed.

e. Designing proposed tent sites in sagebrush, on slopes less than 5 percent and monitoring regularly for site erosion.

2. Eliminate soil compaction on 90 percent of the unit by:

a. Mechanically breaking compacted soil horizons at least 7 inches in depth. Accomplish in conjunction with site preparation and planting.

3. Restore effective vegetative ground cover on at least 90 percent of bare areas (excluding designated sites, trails, and roads).

   a. See (a) under "Contain soil erosion."

   b. Follow-up with shrub plantings along road cut slopes and around perimeters of campsites.

Appendix D

Channel Erosion
Sheet Erosion

Appendix F

Timber Vegetative Management Units

Timber Vegetative Management Units

STILLWATER CAMPGROUND REVEGETATION PROJECT

SILVICULTURE REPORT

I. INTRODUCTION

Several major resource problems currently exist at the Stillwater Campground. Soil erosion and compaction, improper design and location of visitor facilities, and a serious decline in the growth and vigor of the trees threaten to adversely affect the quality of the recreation experience. Steps must soon be taken to mitigate these problems. This report deals with alternatives for improving growth, vigor and the visual quality of the forest component of the campground.

The focus of this report will be the five major regeneration systems. These methods offer a full spectrum of treatment opportunities with respect to both the biological requirements of the tree species and the visual needs of the campground.

Two assumptions are made here. The first is that lodgepole pine is to be the favored species in the future stand. While other species will figure prominently into future stand composition, the campground area is clearly a lodgepole site. This species is well adapted to the site and should perform better than other tree

species. Conventional silvicultural wisdom is that type conversion should be avoided. The second assumption is that artificial reforestation is preferable to natural regeneration. Although the evidence is that the Stillwater site is capable of regenerating naturally, the disadvantages are that natural regeneration takes considerably more time to establish and would require more restrictive protection measures than would planted trees.

II. CURRENT SITUATION

A) Abiotic

The Stillwater Campground is located in T3N,R76W,Sec 34, Grand County, Colorado. It is situated on a peninsula on the west side of Lake Granby at about 8300 feet above mean sealevel. A low east-west running ridge bisects the campground and aspect is primarily north and south. Slope ranges from zero to about 40 percent. Soils and precipitation are described in the soils report for the revegetation plan.

B) Biotic

The forested portion of the campground encompasses about 24 acres. To improve the accuracy of management prescriptions, this area was subdivided into six vegetation management units (VMU's) based on forest stocking, presence of dwarf-mistletoe, and soil condition. A series of inventory plots was installed to gather data on the vegetative component of the various VMU's. Forest vegetation on each plot was sampled using

standard Region 2 Stage II inventory procedures. Additionally, several "walk-through" exams were made to "flesh-out" the quantitative Stage II data.

The forest cover in the campground consists of a more or less even-aged "stand" of lodgepole pine averaging about 95 years of age. There are about 158 trees per acre averaging 9.6 inches DBH and 49 feet in height. Virtually all trees tallied on the plots were greater than 5.0 inches DBH and no tree species other than lodgepole pine were observed either on or off the plots with the exception of two small areas of aspen seedlings/saplings located near the administrative residences. Thus, there is a conspicuous lack of trees in the smaller age classes, as shown in the bar graph in Appendix A. Basal area per acre averages about 80 square feet over the entire area sampled. Damage and disease noted during the inventory include lodgepole dwarf-mistletoe (D-M), dead tops, forked tops, "unhealthy foliage", and mechanical damage (mostly basal and trunk scars) resulting from use and abuse over the years by campers. Site index, determined using Stage II techniques, is about 50; however, this figure undoubtedly reflects the adverse impact on site productivity that dwarf-mistletoe and soil compaction have had. The area is currently in a state of high susceptibility to the mountain pine beetle.

Several aspects of the existing stand deserve elaboration: 1) stand structure, 2) presence of D-M, and 3) susceptibility to attack by mountain pine beetle.

Stand Structure: During Walk-through exams, the only observed regeneration occurred within clusters of ground juniper which in turn were found primarily in the few areas which have received little foot traffic. On all but the narshest lodgepole pine sites on the Sulphur Ranger District, the species regenerates itself very well. Thus, it appears that the lack of regeneration in the campground is most probably the result of the heavy human use of the area. The adverse affects of human use of the area on regeneration will figure prominently in the vegetative rehabilitation recommendations.

Dwarf-Mistletoe: Dwarf-mistletoe is a host specific parasitic plant which adversely affects tree growth, vigor, and seed production and increases susceptibility of the host tree to attack by secondary pests, particularly bark beetles. It also causes direct mortality. The dwarf-mistletoe plant is propagated by seed which is easily spread, both vertically and horizontally, through a forest stand.

As a part of the inventory, the presence of dwarf-mistletoe was evaluated for the stand using Hawksworth's six point rating system. When data from all plots is combined, the stand's average dwarf mistletoe rating is about 3.5. However, during

the inventory, it was observed that a small 5.0 acre area, VMU 1, was only lightly infected. When the data from this VMU was separated from the rest of the campground data, the average rating for VMU 1 was less than 1.0 while that for the rest of the campground was about 5.0. A recent publication by the Colorado State Forest Service recommended that lodgepole pine located in high recreation value areas be removed when individual tree ratings exceed 4.0. The article stated that those with a rating of less than 4.0 may be left if removing them would result in too few trees being left. The presence and degree of infection of dwarf-mistletoe in the Stillwater Campground will have a significant bearing on the course of vegetative rehabilitation of the area.

Mountain Pine Beetle: Attack of lodgepole pine by the mountain pine beetle (MPB) is a recurring problem. For the past several years, Grand County has been experiencing a major eruption of the MPB population. Amman (1977) has developed a scheme for rating the susceptibility of a forest area to attack by the insect. This scheme is currently in use throughout the Rocky Mountain Region. Using it, the location and characteristics of the lodgepole stand in the campground indicate that it is highly susceptible to attack by the MPB and in fact, a number of trees in the campground have been attacked by the beetle in recent years. These attacked trees were removed before the young beetles were ready to emerge and re-attack, thereby reducing tree losses in the campground. Also, a protective

spray program was initiated in the spring of 1984 with the result that loss of trees from MPB attack have been reduced nearly to zero. The MPB is a recurring problem in this area and a vegetative management plan must take its presence into account.

III. PROBLEMS

A summary of the current situation is a statement of the problem: the forest component of the campground is a 95 year old even-aged lodgepole pine stand with virtually no regeneration established in the understory. The stand is of low vigor and is both heavily infected with dwarf-mistletoe and highly susceptible to attack by the mountain pine beetle. The stand is located in a heavily used recreation area in which the visual quality of the landscape is critical.

IV. OBJECTIVE

From a silvicultural point of view, the objectives of this vegetation rehabilitation plan are: 1) to create a stand which is vigorous, relatively free of dwarf-mistletoe, and resistant to attack by the mountain pine beetle; 2) to assure that the new stand is diverse with respect to both species composition and age class structure; 3) to achieve the first two objectives in a manner which will minimize the adverse impacts of the stand establishment effort on the visual resource.

ALTERNATIVES

A. Even-Aged Regeneration

Use of each of the three even-aged regeneration methods, clearcut, seed tree, and shelterwood systems, results in the creation of a new stand in which all trees are more or less the same age. A common drawback to all even-aged systems is that all trees within the regenerated stand will reach a state of susceptibility to attack by the mountain pine beetle at about the same time. Thus, instead of "permanently" reducing the beetle problem, even-aged regeneration merely postpones it. This violates the first objective. With the exception of the shelterwood system, the regeneration cuts of the even-aged system create a very open condition which is not generally perceived as desirable in a campground setting. Additionally, the visual monotony of an even-aged stand is less pleasing than the appearance of a stand in which there is structural diversity. Thus, even-aged regeneration falls short of achieving the second and third objectives, also.

B. Uneven-Aged Cutting Systems

The application of the two uneven-aged cutting methods, individual and group selection, are characterized by two conditions: 1) the stands created are uneven-aged -- that is, at any point in time trees all age classes are present; 2) because regeneration is scattered throughout the stand, it is always subject to influence from the older age classes.

The second objective is automatically met by the use of the uneven-aged system because uneven-aged management results in a patchwork structural arrangement in which all age classes are present. This diversity, coupled with the fact when the system is properly applied, regeneration cutting is fairly inconspicuous, serves to satisfy the visual requirements of the third objective. The degree to which this alternative meets the first objective, that of creating an MPB-resistant, dwarf-mistletoe free stand, requires elaboration.

Under uneven-aged management, the larger size classes that are susceptible to attack by the MPB comprise only a small portion of a stand. Thus, even if these larger trees are attacked, the visual impact on the stand as a whole is minimal. In a sense, then, the stand is somewhat resistant to the insect.

If care is taken in the location and design of the regeneration openings and the prescribed cultural activities are performed, the spread of dwarf-mistletoe to the regeneration can be controlled. These follow-up activities are crucial to the successful use of the even-aged system.

V. PREFERRED ALTERNATIVE

The preferred alternative is the group selection method of the even-aged cutting system since its use assures the attainment of all

three objectives. The patchwork of openings that result from this approach are large enough to provide the environment necessary for survival and growth of lodgepole pine. They are small and dispersed enough that the visual quality of the area will not suffer appreciably. Properly designed and located openings, coupled with the planting of species in addition to pine, should result in the regeneration of a dwarf-mistletoe free stand.

VI. VMU PRESCRIPTIONS

A. Considerations for All Units

1). The Cutting Cycle - The goal is to establish a timber stand that is uneven-aged, consisting of numerous small even-aged groups of trees of several distinct age classes scattered throughout the area. The area occupied by each of these groups should be roughly equal in size. To accomplish this, the stand must be entered periodically and a specified percentage of the area within each of the VMU's cut. The most desirable situation would be to create a new stand with five age classes. Since the current stand is even-aged, this could be accomplished by entering the stand every twenty years for the next 80 years and at the time of each entry, harvesting 20 percent of the area of each VMU. In 80 years, the stand would be composed of small patches of trees of 0, 20, 40, 60, and 80 years of age. Each age class would occupy about

20 percent of the area. However, there is a problem with applying this theoretical solution to the stand at Stillwater. If the final entry of the campground stand were made 80 years from now, the trees harvested at that time would be 175 years old. Considering their current poor vigor, it is doubtful that 20 percent of the current stand could be carried that long. An alternative is to cut 20 percent of the stand in 1985, 20 percent in 2005, 20 percent in 2035, and 30 percent in 2055. Thus, the cycle would be reduced by 20 years and four age classes would be featured instead of five. The chance of carrying the current stand for 60 years is better than the prospect of carrying it for 80 years. This strategy may be more practical than the five age class, twenty year cutting cycle.

2). Cutting Unit Configuration - Dwarf-mistletoe, the most critical factor involved in the determination of cutting unit size, is a problem in all VMU's but VMU 1. Where the parasite is a problem, an opening at least 100 feet across must be made to ensure that the regeneration in the center of the opening is protected from the plant seeds. The shape of the openings need not be circular but the 100 foot minimum opening width must be observed. To the extent possible, openings should be designed to allow direct sunlight into the clearing.

3). Cutting Unit Location - Units should be located in areas where tree vigor and prospects for survival until 2055 are poorest.

4). Pruning - Trees surrounding the regeneration openings must be carefully examined for the presence of dwarf-mistletoe. Branches, especially those on the sides facing an opening, bearing the aerial shoots of the parasite must be pruned off prior to planting the opening. Dwarf-mistletoe surveys followed by pruning must be conducted every other year or the risk of infecting the lodgepole pine regeneration becomes great.

In addition to pruning to eliminate the spread of dwarf-mistletoe to regeneration, a pruning program directed toward increasing the vigor and life expectancy of trees throughout the campground should be initiated. Hawksworth (1973) found that pruning can be used successfully to reduce the severity of the dwarf-mistletoe problem in ponderosa pine stands. The guidelines he developed should be adopted for use in the Stillwater stand.

5). Planting

Species - As previously indicated, lodgepole pine is the preferred species on this site. Englemann spruce, quaking

aspen, cottonwood, limber pine, Douglass-fir, and subalpine fir are other species that can be used in this stand. Together, however, these "other" species should comprise about 50 percent or less of the total number of trees planted. Species mixes for each of the VMU's will be made below. Within an opening which is surrounded by a dwarf-mistletoe infected overstory, lodgepole should be planted in the more protected center and other species used primarily in planting the periphery. Most dwarf-mistletoe seeds fall within 20 feet from their source so for adequate insurance against infection, no lodgepole should be planted within about 35 feet of the edge of such an opening.

Seed Source - Regardless of the species planted, stock should be carefully chosen to match site characteristics of the seed source with those of the Stillwater stand. One way to assure that this match is made is to obtain wildlings from sites similar to the Stillwater stand- preferably from locations on the Sulphur Ranger District. However, planting stock can be obtained from either Forest Service or commercial nurseries when they have quantities of compatible material available. In the long run, it would be best to collect seed from local stands specifically for the Stillwater revegetation project.

Planting Method - Soil compaction has been identified as a problem throughout most of the area and the choice of planting method should address this situation. For hand planting, a shovel should prove adequate. It enables the planter to loosen the soil surrounding the planting spot, providing greater ease in root penetration during the early period of seedling development. Use of a tree spade is highly desirable for it makes possible the transplanting of trees with minimal disturbance of the root systems. It also enables the transplanting of trees much larger than those that can be planted with hand tools. The advantage of planting large trees with the tree spade is that the openings created by group selection can be "instantly" stocked with sapling size trees. These large trees would provide the visual screening that is noticeably lacking in the campground. The disadvantage of the tree spade is that it is relatively costly to use.

Spacing - Proper spacing between planted trees depends upon the size of the planting stock used. For container- or bareroot-stock, four or five feet between trees is probably adequate. If larger trees are transplanted with the tree spade, spacing should be increased. Twelve foot tall transplants should be spaced about eight feet apart.

Site Preparation - The objectives of site preparation in the campground area is to loosen the compacted soil to allow the roots of the newly planted trees to more easily penetrate the soil and to improve the moisture holding qualities of the soil. It is possible that the soil can be broken up by the use of a roto-tiller although the task can also be accomplished with a shovel. The advantage of using a shovel is that damage to the root systems of the surrounding overstory trees would be minimized. It would be best to prepare the soil throughout the planted opening rather than in the spots immediately surrounding the individual trees.

Site Protection - It is important that the planting sites be protected from human traffic so that direct damage to trees, such as trampling, as well as the indirect damage which results from soil compaction can be avoided. Several approaches to site protection can be taken. One is to use man-made barriers such as fences or barricades. Another is to use vegetative barriers, for example ground juniper, to delineate planted areas. Visitor traffic patterns are of course important and should be considered at the time cutting units are designed. Foot paths should be constructed so that they go around the planting areas.

Seedling Protection From Dwarf-Mistletoe - Although frequent pruning of infected branches in the adjacent overstory should do much to reduce the spread of the parasite into the regeneration, an additional step can be taken to inhibit its spread. A physical barrier, such as a cloth mesh, can be used to cover individual lodgepole pine seedlings to intercept seeds or a large covering can be suspended over the opening. In either case, the protective mesh would need to be used only during the brief period when the Dwarf-mistletoe plant disseminates its seed. This period needs to be established precisely but is thought to occur at the end of August.

A second approach to reduce the possibility of dwarf-mistletoe infection of the regeneration is the use of the chemical Ethero. This is an ethelene base substance that kills the aerial portion of the dwarf-mistletoe plant. About two years after application the shoot grows back but in the interim, the plant produces no seed. The use of this chemical for dwarf-mistletoe control is still in the experimental stage, but its future is promising. Currently, the Rocky Mountain Forest and Range Experiment Station is considering the Stillwater Campground as test site for the use of Ethero.

FIS

B. Individual VMU Recommendations

VMU 1

Description: This is a 5.0 acre unit. Aspect is northeast and slope averages about 13 percent. Soil compaction is a problem on most of this unit. Dwarf-mistletoe is generally light; inventory data indicate an average rating of less than 1.0.

Recommendations: Because dwarf-mistletoe is not a major concern in this area, the 100 foot minimum size limitation for regeneration openings need not be observed; however, openings smaller than about 55 feet across may not create the environment necessary for optimum lodgepole growth. Openings should be designed to provide for direct sunlight. In addition to lodgepole pine, aspen, subalpine fir, and Englemann spruce should grow well here. Fir, however, is susceptible to rot resulting from physical injury and should not be planted near camping sites where they are more liable to be subjected to physical damage from campground visitors.

2) VMU 2

Description: This is a 5.3 acre unit. Aspect is generally south and slope averages about 10 percent. The

extent of soil compaction on this unit is less than that of VMU 1. Dwarf-mistletoe is a problem on this unit.

Recommendation: Because this unit has a southerly exposure and stocking is somewhat sparse, orientation of cutting units to provide full sunlight is not necessary. Partial shade, 30 to 60 percent, is desirable to improve moisture availability for seedlings. Existing openings within this unit may be expanded and planted or they may be large enough to plant without modification. However, since areas of this VMU may be on "fringe" Uinta/Leavitt soils, concurrence of the soil scientist should be obtained before modifying or planting openings. Douglas-fir and limber pine, in addition to lodgepole, should perform well on this site. If the 100 foot minimum opening size cannot be met without exposing the clearings to too much direct sunlight, maintain the sub-minimum opening size and plant Douglas-fir and limber pine in the area within 35 feet of dwarf-mistletoe infected overstory trees.

VMU 3

Description: This unit is about 0.7 acres in size. Aspect is northeasterly and slope averages about 16 percent. Tree vigor is very poor in this area due to both heavy dwarf-mistletoe infection and severe

mechanical damage. Stocking is very sparse. A very serious erosion problem exists in this VMU along the high water line of Lake Granby. Soil compaction is extensive.

Recommendation: This may be the most challenging VMU to rehabilitate, primarily because of the soils problems. The soil must be thoroughly broken up for site preparation. There are few trees in this VMU and if it is not desirable to remove any to create the openings necessary to regenerate lodgepole, then underplant the existing stand with spruce and Douglas-fir. Cottonwood may also do well if irrigated for several years after planting.

VMU 4

Description: This VMU is about 5.3 acres in size. Aspect is southeasterly and slope averages about 10 percent. This area is similar to VMU 2 in that the unit occupies both Uinta and Leavitt soils. Soil compaction is not as severe here as it is in units 1, 2, or 3. The stand is sparsely stocked and numerous openings occur. Dwarf-mistletoe is a problem in this VMU.

Recommendations:Because this unit has a southerly exposure and stocking is somewhat sparse, orientation of cutting units to provide full sunlight is not

recommended. Partial shade, 30 to 60 percent, is desirable to improve moisture availability for seedlings. With the concurrence of the soil scientist, existing openings within this unit may be expanded and planted or they may be large enough to plant without modification. On this site, Douglas-fir and limber pine should be the best performers in addition to lodgepole pine. If the 100 foot minimum opening size cannot be met without exposing the clearings to too much direct sunlight, maintain the sub-minimum opening size and plant Douglas-fir and limber pine in the area within 35 feet of dwarf-mistletoe infected overstory trees.

VMU 5

Description: This unit is about 4.6 acres. Aspect is northwesterly and slope averages about 9 percent. Stocking is light and tree vigor is poor. Parts of the stand are somewhat open. Soil erosion and compaction are serious problems on this unit. Dwarf-mistletoe is also a problem.

Recommendations: Size of the regeneration openings should reflect the presence of dwarf-mistletoe in the surrounding stand; that is, the 100 foot minimum clearing size should be observed. Openings should be designed to

allow sunlight in. In addition to lodgepole pine, spruce and Douglas-fir can be used to restock this VMU.

VMU 6

Description: The area of this VMU is about 3.5 acres. Aspect is northerly and slope averages about 10 percent. Stocking is moderate. Dwarf-mistletoe is a problem in this VMU.

Recommendations: The 100 foot minimum opening size should be observed in this VMU. Clearings should be designed to allow sunlight in. Englemann spruce, Douglas-fir, aspen, and subalpine fir may be planted in addition to lodgepole pine. Fir, however, is susceptible to rot resulting from physical injury and should not be planted near camping sites where they are more liable to be subjected to injury from campground visitors.

VII. ONGOING NEEDS

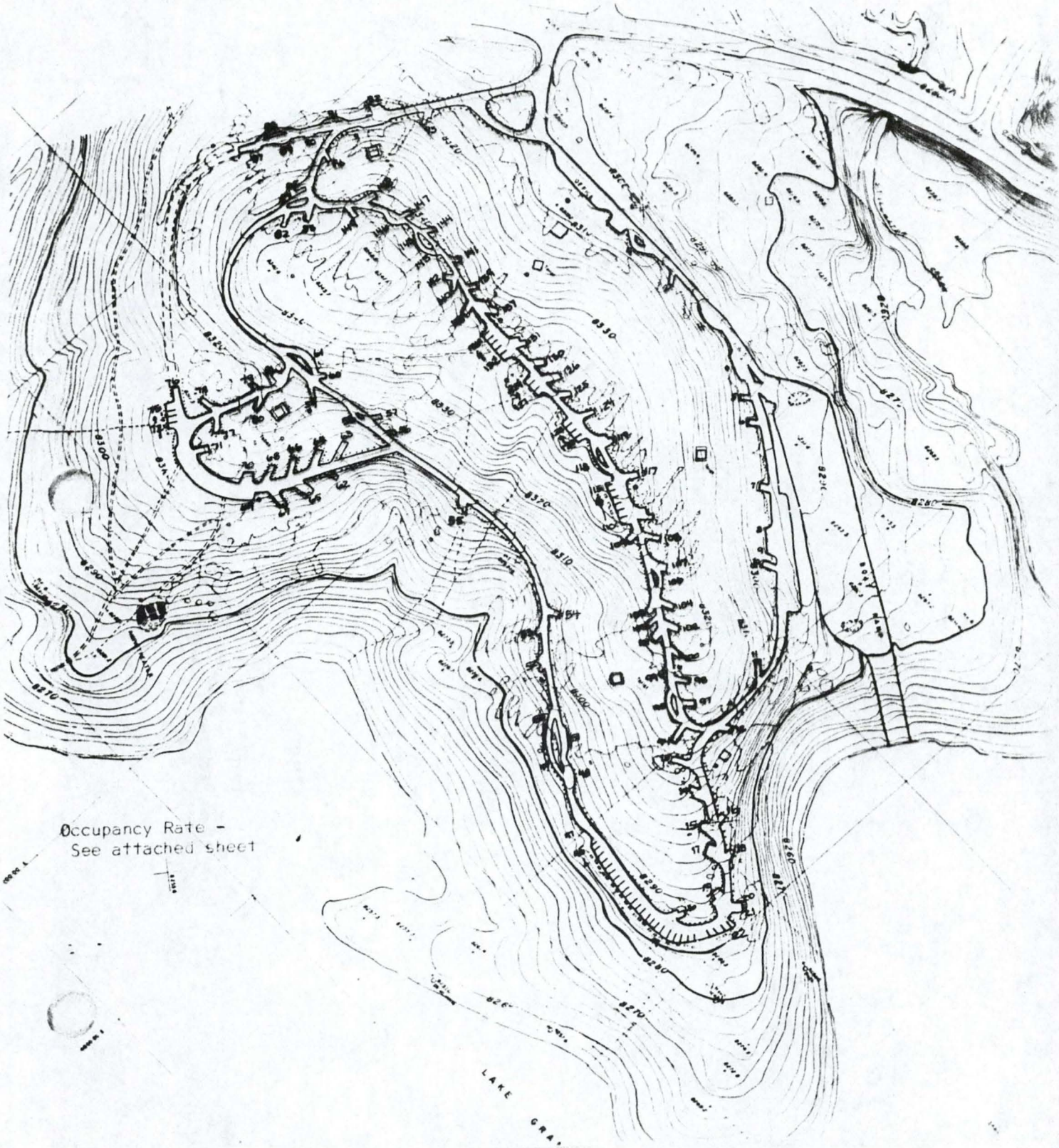
To successfully complete the vegetative rehabilitation of the Stillwater Campground, several cultural activities must be periodically accomplished. 1) Particular attention must be paid to the dwarf-mistletoe problem since, from the standpoint of the lodgepole pine overstory, it is the single most important factor influencing both stand vigor and choice of regeneration system. As

previously indicated, surveys must be conducted every other year to asses the dwarf-mistletoe situation in both the overstory and the regeneration. Pruning the infected branches of overstory trees surrounding the regeneration openings as well as pruning any infections that may occur in the regeneration is essential. It is also recommended that pruning be done to improve the vigor and life expectancy of the entire stand. Finally, it is recommended that additional insurance against infection of the regeneration be obtained by the installation the protective cloth barriers mentioned earlier or by initiating an Ethero sray program. 2) Hazard tree reduction of course must continue to ensure the safety of campground users. 3) For the duration of the current outbreak of the MPB, the beetle spray program must be continued. 4) Barriers for the protection of regeneration from trampling and the protection of the soil from compaction must be maintained. 5) The future regeneration entries specified in this report must be made so that the diversity that will assure the resistance to the maladies that currently plague the Stillwater Campground can be achieved.

It is not reasonable to expect that the goals of this vegetative managenment plan can be achieved in one treatment in one fiscal year. It is critical that this plan be carried out over time until it has been completed. Money and manpower must be committed beyond the current year.

This is a formidable task for an organization such as the Forest Service which faces constant personnel changes and chronic budget constraints, but it is undoubtedly the key to the successful completion of this plan.

Appendix G



Occupancy Rate -
See attached sheet

Visitor Occupancy
Stillwater Campground - 1984

Site #	Season Percent	Weekday Percent	Weekend Percent*
1	30	07	77
2	35	15	77
3	Closed	Closed	Closed
4	35	15	77
5	43	25	80
6	66	41	77
7	46	20	70
8	64	53	87
9	55	39	90
10	46	27	87
11	64	53	87
12	36	14	83
13	Host	Host	Host
14	61	47	90
15	56	42	87
16	70	58	97
17	69	58	93
18	77	69	93
19	63	47	97
20	50	34	83
21	57	45	83
22	56	45	80
23	33	17	67
24	46	30	80

Site #	Season Percent	Weekday Percent	Weekend Percent*
25	31	09	77
26	16	08	50
27	23	0	73
28	19	01	57
29	23	05	63
30	23	05	63
31	26	09	60
32	24	08	60
33	22	06	57
34	28	09	67
35	27	05	73
36	24	05	67
37	19	03	53
38	19	03	53
39	24	03	70
40	27	13	57
41	21	05	57
42	27	09	63
43	18	0	57
44	26	11	57
45	36	17	77
46	56	45	80
47	48	31	83
48	41	20	87
49	76	55	97
50	79	70	83

Site #	Season Percent	Weekday Percent	Weekend Percent*
51	78	70	93
52	89	84	100
53	81	78	87
54	45	25	87
55	67	61	80
56	48	28	90
57	34	16	73
58	57	14	83
59	44	23	87
60	26	0	80
61	55	42	83
62	80	75	90
63	Host	Host	Host
64	56	42	87
65	90	88	97
66	60	48	83
67	83	80	90
68	72	64	90
69	71	65	83
70	53	39	83
71	75	67	93
72	39	23	73
73	23	11	50
74	19	0	60
75	21	03	60
76	71	63	90

Site #	Season Percent	Weekday Percent	Weekend Percent*
77	43	22	87
78	73	66	90
79	63	55	80
80	53	41	80
81	30	08	77
82	59	47	83
83	41	22	83
84	67	59	83
85	45	30	77
86	39	19	83
87	54	41	83
88	33	11	80
89	29	09	70
90	32	08	83
91	Host	Host	Host
92	61	53	77
93	37	22	70
94	64	53	87
95	Closed	Closed	Closed
96	Host	Host	Host
97	83	78	93
98	83	77	97
99	61	48	87
100	81	77	90
101	69	61	87
102	70	61	90

Site #	Season Percent	Weekday Percent	Weekend Percent*
103	70	63	87
104	84	78	97
105	39	22	77
106	60	45	90
107	65	55	87
108	72	64	90
109	31	09	77
110	27	08	47
111	14	0	43
112	13	0	40
113	18	03	50
114	13	0	40
115	18	0	57
116	57	42	90
117	Host	Host	Host
118	58	48	80
119	73	30	87
120	21	09	47
121	06	0	20
122	22	07	53
123	18	0	57
124	66	55	90
125	67	56	90
126	69	63	83
127	16	0	50
128	21	06	53

Site #	Season Percent	Weekday Percent	Weekend Percent*
129	21	03	60
130	51	40	83
131	53	38	87
132	22	0	70
133	22	11	47
134	14	01	40
135	18	08	40
136	27	03	77
137	57	42	90
138	61	45	93
139	51	34	87
140	62	50	87
141	41	23	80
142	55	39	90
143	34	13	80
144	43	22	87
145	53	39	83
146	47	31	80
147	40	22	80
148	61	48	87
149	44	25	83
Season Average:	46	32	77

* Weekend use is from 1800 Friday afternoon until 1800 Sunday afternoon.